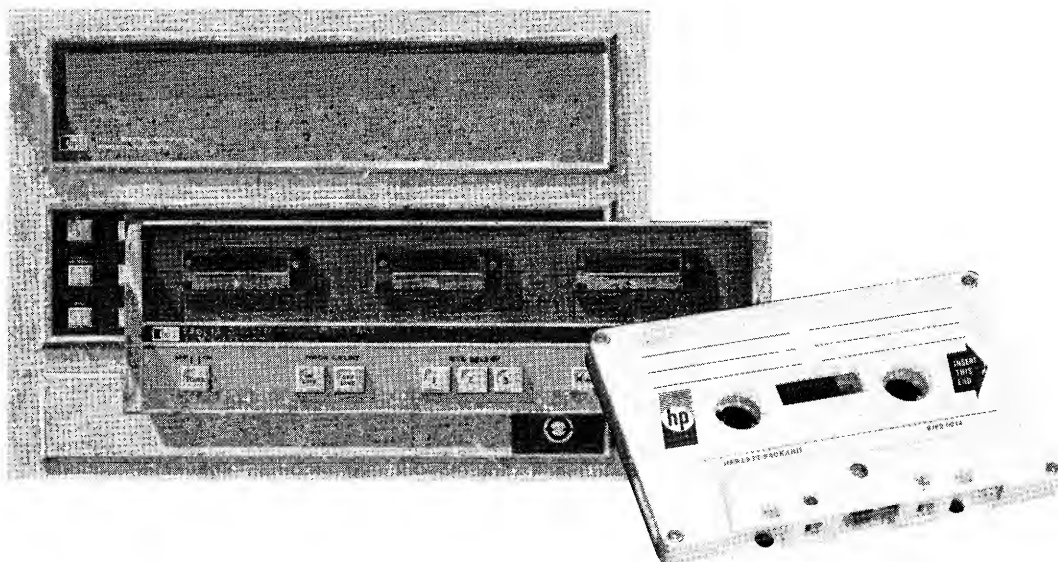


CASSSETTE OPERATING PROCEDURES

# CASSETTE OPERATING SYSTEM



**HP 85001A**  
**Cassette Unit Software**

JUNE 1972

HEWLETT  PACKARD

## CONVENTIONS USED IN THIS MANUAL

### OPERATING CONVENTIONS

### IMPORTANT

Type the carriage return key after *every* line of input that you type in on the keyboard or teleprinter.

Any output question that requires a yes or no answer may be answered with

YES

or

NO

or with only the first letter if you wish:

Y

or

N

### FLOWGRAPH CONVENTIONS

Any word with all letters capitalized is a printout; any underlined all-capitalized word is an operator input.

## CASSETTE OPERATING SYSTEM

### HP Software for an 85001A Cassette Input/Output Unit

This manual applies directly to the programs defined (by part number) in Appendix D.

See the yellow MANUAL CHANGES sheet enclosed for later versions of the software.

HEWLETT-PACKARD CO., 1501 Page Mill Road, Palo Alto, Calif. U.S.A.

Manual Part No. 85001-90039  
Microfiche Part No. 85001-90040

JUNE, 1972



## CONTENTS

Section	Page	Section	Page
I INTRODUCTION . . . . .	1-1	Call Statements . . . . .	6-2
Scope . . . . .	1-1	Functions . . . . .	6-3
COS Overview . . . . .	1-1	Compilation Procedures . . . . .	6-3
Operating the Cassette Unit . . . . .	1-1	Compiler Description . . . . .	6-3
Cassette Nomenclature . . . . .	1-1	Compiler Operation . . . . .	6-3
Tape Format . . . . .	1-2	References . . . . .	6-4
Front Panel Controls . . . . .	1-4	BREAK Option . . . . .	6-4
Loading the Cassette . . . . .	1-4	Preparation . . . . .	6-4
Unloading the Cassette . . . . .	1-4	Operating Procedures . . . . .	6-5
Write-Protecting the Cassette . . . . .	1-4	Object Program Execution Messages . . . . .	6-6
Minimizing Print-Through . . . . .	1-4	Cassette FORTRAN Messages . . . . .	6-6
II THE EXEC . . . . .	2-1	VII CASSETTE BCS RELOCATING LOADER . . . . .	7-1
General Information . . . . .	2-1	General Information . . . . .	7-1
The System Tape . . . . .	2-1	BCS Environments . . . . .	7-1
Loading the EXEC . . . . .	2-2	Description . . . . .	7-1
Loading Programs from a System Tape . . . . .	2-8	Standard vs. Cassette BCS . . . . .	7-1
Creating a New System Tape . . . . .	2-8	Operation . . . . .	7-3
Configuring the EXEC . . . . .	2-10	Configuration . . . . .	7-3
EXEC Error Messages . . . . .	2-11	Loading . . . . .	7-3
III CASSETTE ALGOL . . . . .	3-1	Ending . . . . .	7-3
General Information . . . . .	3-1	References . . . . .	7-3
Cassette I/O in an ALGOL Program . . . . .	3-1	Programming Information . . . . .	7-3
Compiler Description . . . . .	3-1	I/O Configuration at Load Time . . . . .	7-3
References . . . . .	3-1	Execution of Object Programs . . . . .	7-3
BREAK Option . . . . .	3-1	Operating Procedures . . . . .	7-4
Programming Information . . . . .	3-1	Writing the New File . . . . .	7-11
Compilation Procedure . . . . .	3-1	Creating a New Cassette BCS . . . . .	7-11
IV CASSETTE ASSEMBLER . . . . .	4-1	General . . . . .	7-11
General Information . . . . .	4-1	Preparation . . . . .	7-11
Description . . . . .	4-1	Operating Procedures . . . . .	7-12
Operation . . . . .	4-1	Reconfiguring Cassette BCS . . . . .	7-12
Cross Reference Capability . . . . .	4-1	Description . . . . .	7-12
References . . . . .	4-1	Operating Procedures . . . . .	7-15
BREAK Option . . . . .	4-1	Messages . . . . .	7-16
System Tape Organization . . . . .	4-1	VIII CASSETTE SYMBOLIC EDITOR . . . . .	8-1
Operating Procedures . . . . .	4-1	General Information . . . . .	8-1
V CASSETTE CROSS REFERENCE TABLE		Description . . . . .	8-1
GENERATOR (XREF) . . . . .	5-1	References . . . . .	8-1
General Information . . . . .	5-1	BREAK Option . . . . .	8-1
Description . . . . .	5-1	Operating Procedures . . . . .	8-1
Execution Environments . . . . .	5-1	Source File Number Question . . . . .	8-1
References . . . . .	5-1	Meaning of /P Command . . . . .	8-1
BREAK Option . . . . .	5-1	IX CASSETTE BASIC . . . . .	9-1
Operating Procedures . . . . .	5-1	General Information . . . . .	9-1
System Tape Organization . . . . .	5-2	Loading the BASIC Interpreter . . . . .	9-1
VI CASSETTE FORTRAN . . . . .	6-1	Editing . . . . .	9-1
General Information . . . . .	6-1	Cassette File Management . . . . .	9-1
Programming Information . . . . .	6-1	BREAK Capability . . . . .	9-1
I/O for a Cassette FORTRAN Program . . . . .	6-1	System Commands . . . . .	9-2
Accessing the Cassettes . . . . .	6-1	Statements . . . . .	9-2
I O Statements . . . . .	6-1	Error Messages . . . . .	9-7

## CONTENTS (cont'd)

## APPENDIX

A. PROTECTED BINARY CASSETTE LOADER . . . . .	A-1	Operating Procedures for the 2116 . . . . .	B-2
Description . . . . .	A-1	Operating Procedures for the 2100 . . . . .	B-2
Procedures for the 2116 . . . . .	A-1	Programming Information . . . . .	B-3
Checksum Option . . . . .	A-1	ASSEMBLY Environment . . . . .	B-3
Procedures for the 2100 . . . . .	A-1	FORTTRAN Environment . . . . .	B-4
Checksum Option . . . . .	A-2	BASIC Environment . . . . .	B-4
Error Conditions . . . . .	A-2	Absolute Program Starting Address . . . . .	B-4
Contents of PBCL . . . . .	A-2	Error Condition . . . . .	B-4
Restoration Procedures for the 2116 . . . . .	A-3		
Restoration Procedures for the 2100 . . . . .	A-4	C. CASSETTE SIO DRIVER ERROR MESSAGES	
Alternate Decks . . . . .	A-4	MESSAGES . . . . .	C-1
B. SYSTEM LOADER (SYSLD) . . . . .	B-1		
Description . . . . .	B-1	D. SOFTWARE APPLICABILITY . . . . .	D-1
Operation . . . . .	B-1		

## ILLUSTRATIONS

Figure	Page	Figure	Page
1-1. Cassette Nomenclature . . . . .	1-2	6-1. System Tape with FORTRAN Compiler . . . . .	6-4
1-2. Cassette Tape Format . . . . .	1-3	6-2. Cassette FORTRAN Compilation	
1-3. Loading the Cassette . . . . .	1-5	Procedures Flowgraph . . . . .	6-8
1-4. Front Panel Controls . . . . .	1-6	6-3. Example Source Program (Deck 1, File 1) . . . . .	6-9
		6-4. Compiler Operation Printout . . . . .	6-10
2-1. SIO and Non-SIO Program Core Maps . . . . .	2-2	6-5. Data on File 1 of Deck 2 . . . . .	6-11
2-2. System Tape Format . . . . .	2-2	6-6. Execution of the Object Program . . . . .	6-11
		7-1. Example Program Using DEF Format . . . . .	7-4
3-1. Cassette ALGOL Compilation . . . . .	3-2	7-2. Cassette BCS System Tape Organization . . . . .	7-6
3-2. Example ALGOL Compilation Printout . . . . .	3-4	7-3. Cassette BCS Operating Procedures	
		Flowgraph . . . . .	7-7
4-1. Assembler System Tape Organization . . . . .	4-1	7-4. Cassette BCS Example Printout . . . . .	7-8
4-2. Assembler Operating Procedure Example		7-5. Example System Tape for Creating a	
Printout . . . . .	4-5	New BCS . . . . .	7-13
4-3. Dump of Binary File Produced (on Deck 3). . . . .	4-5	7-6. Making a New Cassette BCS Printout . . . . .	7-14
4-4. Assembler Operating Procedures Flowchart . . . . .	4-7		
		8-1. Cassette Symbolic Editor Operating	
5-1. XREF System Tape Organization . . . . .	5-2	Procedures Flowgraph . . . . .	8-4
5-2. XREF Operating Procedures Flowgraph . . . . .	5-3	8-2. Edit Example . . . . .	8-5

## TABLES

Table 1	Page	Table	Page
1-1. Paper-Tape/Cassette Input/Output Equivalents .	1-1	7-1. LOAD Responses . . . . .	7-2
2-1. EXEC Commands . . . . .	2-4	7-2. Error Messages for Object Programs Produced by Cassette BCS . . . . .	7-4
2-2. System Tape Edit Responses . . . . .	2-9	7-3. ERROR Message for Reconfiguring Cassette BCS . . . . .	7-15
2-3. EXEC Error Messages . . . . .	2-11	7-4. Cassette BCS Messages . . . . .	7-16
3-1. Cassette ALGOL Messages . . . . .	3-3	7-5. Cassette BCS Messages . . . . .	7-17
4-1. Assembler Messages . . . . .	4-6	8-1. Responses to the Symbolic Editor . . . . .	8-2
5-1. Cassette Cross Reference Table Generator Messages . . . . .	5-2	8-2. Cassette Symbolic Editor Messages . . . . .	8-3
6-1. Cassette FORTRAN Functions . . . . .	6-3	9-1. Commands . . . . .	9-3
6-2. Object Program Execution Messages . . . . .	6-6	9-2. Statements . . . . .	9-5
6-3. Cassette FORTRAN Messages . . . . .	6-7	9-3. Cassette BASIC Error Messages . . . . .	9-7

## SECTION I INTRODUCTION

### SCOPE

This manual describes operating procedures for Cassette Operating System software used in an HP 2100A Computer.\* This section describes how to operate the HP 85001A Cassette Input/Output Unit. Other sections detail the software procedures.

### IMPORTANT

You should be familiar with the 85001A front panel features and operations before you attempt the procedures in this manual. See Figure 1-4.

The inside cover describes the operating and flowgraph conventions used in this manual.

### COS OVERVIEW

The EXECutive program is the heart of the Cassette Operating System. The EXEC has two major functions:

- tape manipulation (positioning and copying, for example).
- loading and beginning execution of other programs such as the FORTRAN Compiler or user-written programs.

The *System Loader* is a program that gives the EXEC its ability to load and execute other programs; the System Loader also allows those programs to return control to the EXEC when they've finished their tasks.

Many programs described in this manual are also available for paper-tape operating systems; example programs are the FORTRAN Compiler and the Symbolic Editor. Most of the programs common to both operating systems differ only slightly between the paper-tape and the cassette versions. Where the differences are slight, we've noted the differences and referenced other Hewlett-Packard publications for full documentation of the programs.

The paper-tape and cassette operating systems may be equated as follows:

*Table 1-1. Paper-Tape/Cassette Input/Output Equivalents*

Paper-Tape	Cassette
Photoreader	Deck 2
Punch	Deck 3

### OPERATING THE CASSETTE UNIT

#### Cassette Nomenclature

Refer to Figure 1-1. There are two versions of the Hewlett-Packard cassette: one (part no. 9162-0044) has 300 feet of tape, the other (part no. 9162-0048) has 150 feet of tape.

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\*Differences between the 2100A and the 2116 series computers are noted in the procedures.

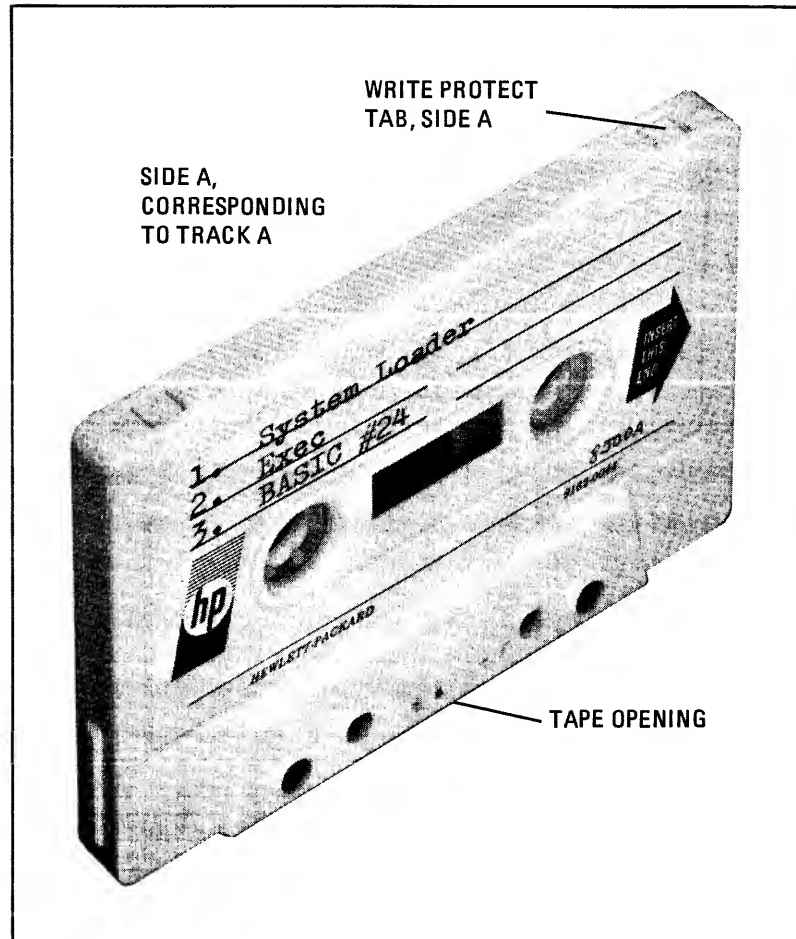


Figure 1-1. Cassette Nomenclature

There are two *tracks* on the tape: A and B. They are independent of each other. The Cassette Unit may read or write on either of the tracks. Each side of the cassette corresponds to a track. How you position the cassette in the Cassette Unit deck determines which track the unit will write on or read from (explained in **LOADING THE CASSETTE**, in this section).

## Tape Format

Figure 1-2 shows the format of a typical tape.

Data is recorded serially on the tape. The first and last 10 inches of the tape are clear leader; the cassette unit senses the clear leader portions of the tape as Beginning-of-Tape (BOT) and End-of-tape (EOT).

No data can appear on the first 10 inches after BOT (the Cassette Unit automatically leaves 10 inches of blank tape before writing data). The purpose of the blank tape is to make sure that any spliced sections of tape have passed the READ/WRITE head.

A *character* consists of 8 bits; each bit cell is 0.00182 inches wide. Each character is 0.0145 inches long; characters are separated by a 0.0054" *character gap* (a section of blank tape, three bits wide).

A *record* consists of one or more characters. Records are separated by 0.25 inch *inter-record gaps* of blank tape.

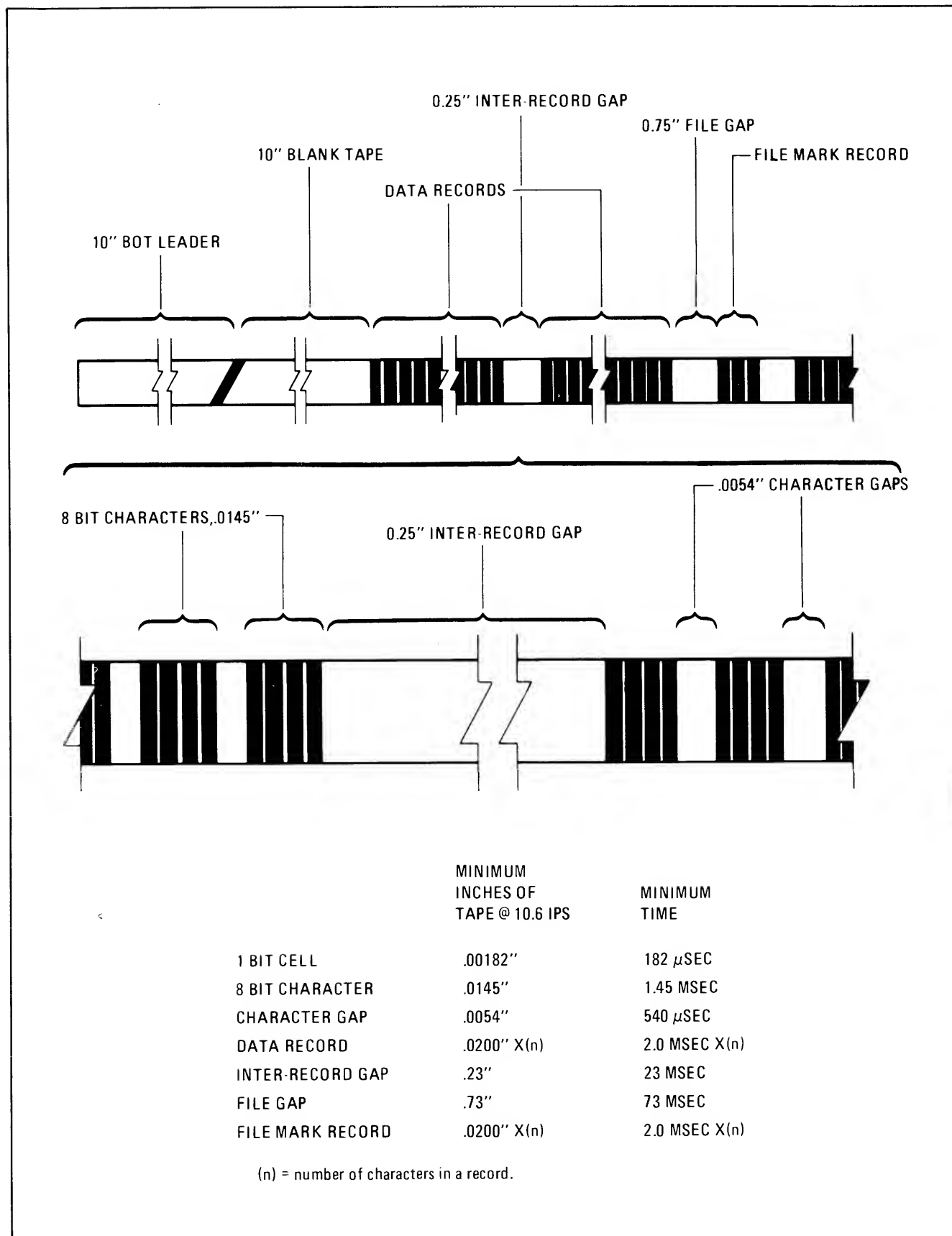


Figure 1-2. Cassette Tape Format

A *file* contains one or more records. Each tape contains one or more files. A *file mark* and a 0.75 inch *file gap* precede each file. Figure 1-2 illustrates a file gap; a file mark is the first record after the file gap. When recording, COS software writes a single-character record as a file mark; when reading, though, COS software doesn't use the information in the file mark.

A file gap (which is a section of blank tape anyway) and a file mark should never precede the first data record; the reason is that the file gap would appear to be only an extension of the blank tape at the beginning of the tape, so the file mark would appear to be the first data record.

**Front Panel Controls** Figure 1-4 describes the front panel controls of the 85001A Cassette Input/Output Unit.

Please note the distinction between the OFF LINE *mode* and the off-line *option* (85001A-003). Any cassette unit will operate in the OFF-LINE mode; the off-line option allows the Cassette Unit to input data directly from the teleprinter (rather than through the computer), and allows the teleprinter to directly input and list data from the cassette unit (without using a computer).

**Loading the Cassette** Refer to Figure 1-3. Hold the cassette with the tape opening to the right and the side up that you want to read from or write on. Insert the cassette into the deck's loader opening until the cassette locks into place. Next, put your thumb on the deck's loading bar and press the deck down in a single swift motion. When the tape engages the deck mechanism, the deck automatically enters the REWIND cycle until the read/write head senses the leader; at this time, the deck enters the HALT cycle and turns its READY indicator on.

**Unloading the Cassette** To unload a cassette, press up on the eject lever at the bottom of the loader lip. The deck automatically rewinds the tape until the unit senses the Beginning-of-Tape clear leader. Again, press the eject lever . . . the deck will pop up and eject the cassette.

Note that the cassette cannot be removed from the Cassette Unit unless the tape is positioned on clear leader (BOT).

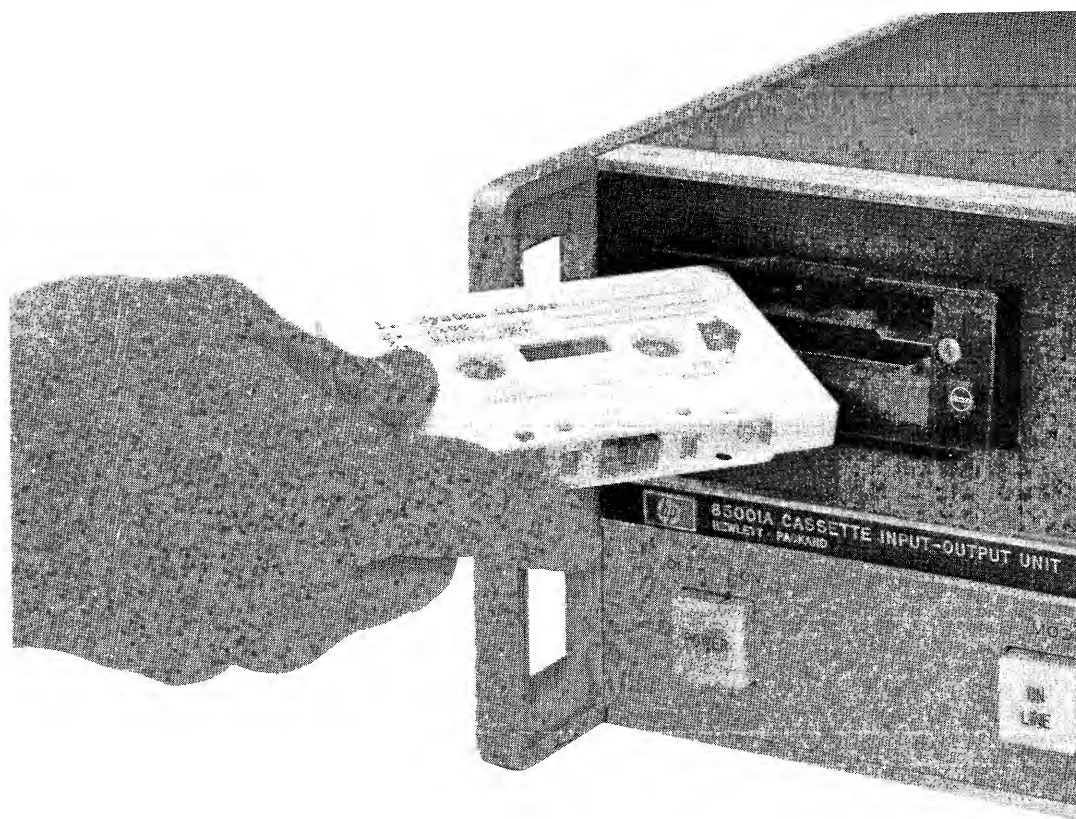
**Write-Protecting the Cassette** You may have a program you want to protect from an accidental write-over. If so, you can protect the track that the program is written on.

At the top of the cassette, there are two tabs. If you want to write-protect Track A, punch out the tab that's above the insertion arrow on the cassette label on the Track A side.

With the tab out, the Cassette Unit cannot write on that track in either the OFF-LINE or ON-LINE mode. You may protect both tracks.

**Minimizing Print-Through**

Every tape, if not otherwise used, should be rewound every six months to prevent "print-through" between adjacent layers.



*Figure 1-3. Loading the Cassette*

- 1 **POWER.** Power to the 85001A is on when the switch is in the depressed position and is lit.
- 2 **ON-LINE MODE.** Press the pushbutton switch to select the ON-LINE mode of 85001A operation. In the ON-LINE mode, the 85001A is under computer control (all of the 85001A front panel switches — except POWER and OFF-LINE — are disabled). The front panel switch lights stay lit to indicate 85001A operation under computer control.
- 3 **OFF-LINE MODE.** Press the pushbutton switch to select the OFF-LINE mode of operation for the 85001A. In the OFF-LINE mode, all front-panel switches are enabled. The 85001A may be operated in any one of several cycles in the OFF-LINE mode. Each of the cycles is discussed below with the appropriate switch. Cycles not associated with a particular switch are discussed at the end.
- 4 **DECK SELECT.** When you're operating the 85001A in the OFF-LINE mode and in either the HALT or REWIND cycle, you may select Deck 1, 2 or 3 by pressing the appropriate switch. The selected deck is then under the control of the COMMAND switches.
- 5 **HALT CYCLE.** You can select the HALT cycle by pressing the HALT switch; or the 85001A automatically goes to the HALT cycle at the end of a REWIND or SEARCH cycle. HALT clears any OFF-LINE cycle in progress and lets you make a new deck or cycle selection. In fact, the only time you can make a new deck or COMMAND selection is after the 85001A has entered the HALT cycle.
- 6 **REWIND CYCLE.** To start the REWIND cycle, press the REWIND button if the light for the deck you want to rewind is lit. If it isn't lit, press HALT, select a deck and then press REWIND. The selected deck rewinds at 55 ips until the supply reel accumulates all the tape and the unit senses the leader tape.

After the unit senses the leader, the tape stops, the READY light above the rewound deck lights, and the 85001A enters the HALT cycle. During REWIND of one deck, you may select any other deck for another operation.

**OFF-LINE SEARCH CYCLE.** The search cycle passes through files without reading them.

To enter the search cycle, press the OFF-LINE switch and the READ switch at the same time. The unit skips over the first record and lights the READ and HALT lights at the same time, indicating that there is more than one record in the file. The unit continues moving the tape forward (at 10 inches per second) until the read-head senses a file gap followed by a file mark record, or until you press the HALT button. When the unit senses the file gap, the read-head passes over the file mark record and stops, with the head positioned in the inter-record gap which follows the file mark record.

### IMPORTANT

The following cycles are available only with the OFF-LINE option 85001A-003.

- 2 **READ CYCLE\*.** To enter the READ cycle press the READ pushbutton switch to light it. The Cassette Unit will begin reading at the current position of the tape.

The unit reads from the selected deck into the 100-character MOS buffer until the read-head senses an ASCII carriage return character. The buffer then unloads one character at a time to the teleprinter.

The READ cycle will continue until the read-head senses a file gap and a file mark, or the End-of-Tape, or until you press the HALT switch.

If the read-head doesn't sense a carriage return after the MOS buffer has stored its maximum count (98 characters), the buffer cannot unload into the teleprinter.

---

\*In units that do not have the Off-Line Option, pressing READ advances the tape at 10 ips until the unit senses an end-of-file mark; then the tape stops and the unit enters the HALT cycle.

Figure 1-4. Front Panel Controls

**CAUTION**

Do not enter the WRITE or WRITE FILE GAP cycles unless you have the Off Line option; entering the cycles without the Off-line option will erase previously recorded data.

**8 WRITE CYCLE.** To enter the WRITE cycle, press the WRITE pushbutton to light it. If you've just inserted the cassette and have made no operation on it, the tape is positioned at the Beginning-of-Tape (BOT). When you press WRITE, the tape will move 10 inches past the leader portion of the tape and then stop.

Use the teleprinter to write on the tape. You may type up to 72 characters per line on the teleprinter. The teleprinter asynchronously transmits the characters to the Cassette Unit's MOS buffer. The MOS buffer accumulates the data from the teleprinter until you type the Carriage Return key on the teleprinter, and then outputs the data (as one record) onto the selected deck.

The Cassette Unit remains in the WRITE cycle until you press HALT or until there is no more tape on the cassette to write on.

**WRITE FILE GAP CYCLE.** The file gap cycle allows the operator to write a file gap on the tape in the selected deck.

To enter the cycle, press OFF-LINE and WRITE at the same time. The WRITE and HALT lamps glow momentarily, indicating that the Cassette Unit is writing the file gap. After the file gap has been written, the HALT lamp cuts out but the selected deck remains in the WRITE mode waiting for you to write the file mark.

Write the file mark (any single-character record) as you would any other record. The WRITE file gap cycle ends when the read/write head senses End-of-Tape, or when you press the HALT button.

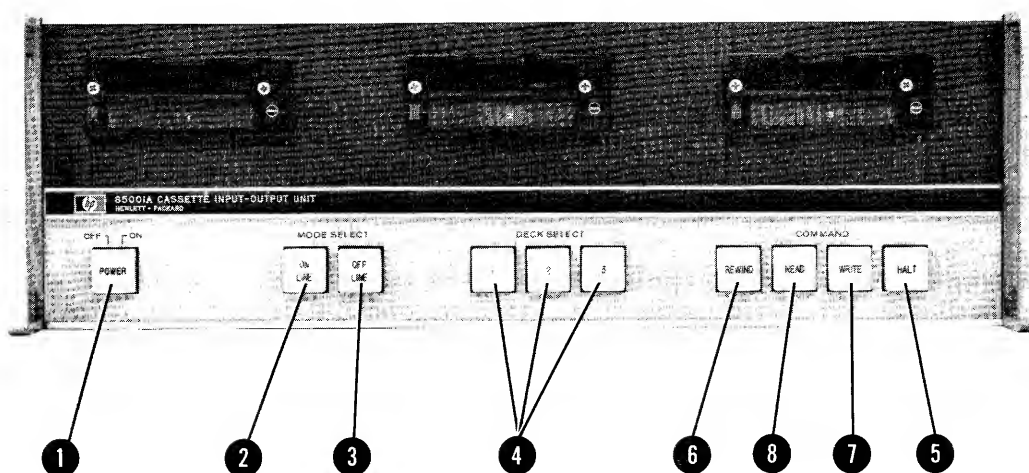


Figure 1-4. Front Panel Controls (cont'd)

## SECTION II

### THE EXEC

#### GENERAL INFORMATION

The EXEC is the heart of the Cassette Operating System; the EXEC has two major — and independent — functions:

- tape manipulation
- loading and executing other programs.

The EXEC, as tape manipulator, allows you to

- position a tape to any file on any deck.
- copy files and verify that the tape was accurately copied.
- list ASCII files on the display device.
- list binary-formatted files on the display device in octal format.
- write ASCII files on tape.
- file portions of core on tape in absolute binary format.
- build a new “system tape” (defined below).

The EXEC’s tape manipulation function is independent of its function of loading and executing other programs. The EXEC (which is in core temporarily) passes your load-and-execute command to the System Loader, which is always in core. The System Loader then loads the program from one of the decks into core, overlaying the EXEC.

After the loaded program executes, it passes control back to the System Loader which then automatically reloads the EXEC from the second file of the cassette in Deck 1.

The EXEC operates in the SIO (Software Input/Output) environment. For more on the SIO environment see the HP ASSEMBLER Manual (02116-9014), Appendix E.

Figure 2-1A is a core map showing the configured EXEC (configuration of the EXEC is explained later in this section). Figure 2-1B shows the core map after the System Loader has loaded in a program that operates in the SIO environment. (An example of such a program is the FORTRAN Compiler.) Note that both the System Loader and the SIO environment remain in core.

Figure 2-1C shows a core map with a program that does not operate in the SIO environment (BCS is an example non-SIO program.)

#### THE SYSTEM TAPE

The system tape is a tape that *always* contains the System Loader in File 1, the configured EXEC in File 2, and any other programs in the other files. See Figure 2-2.

The configured EXEC in File 2 contains a Program Name Table, which is a list of the names of all programs on the system tape except the EXEC and the System Loader. (The EXEC correlates the name of each program to its location on the tape).

To add or remove a program from the system tape, see CREATING A NEW SYSTEM TAPE in this section.

To change system tapes while the EXEC is in core, remove the current system tape cassette from Deck 1 and insert the new tape; then type EXEC. The EXEC command causes the System Loader to load the new EXEC from Deck 1 into core.

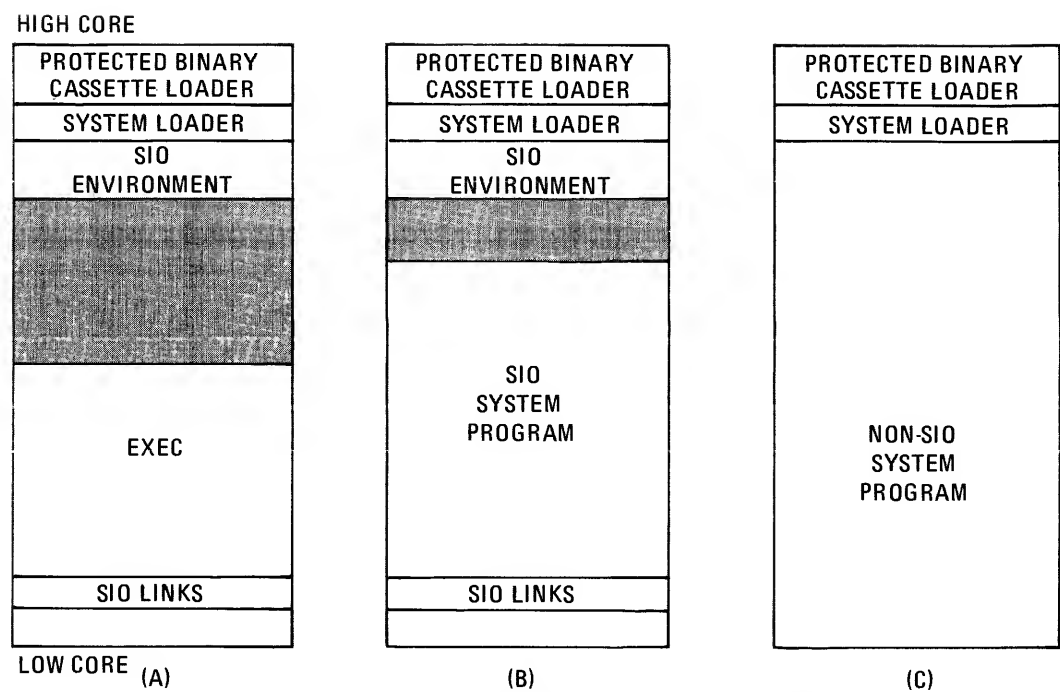


Figure 2-1. SIO and Non-SIO Program Core Maps

The reason that you need a new EXEC is because each EXEC has a program name table for its own system tape.

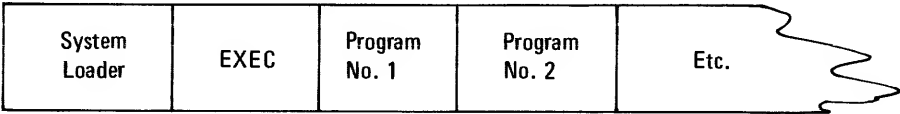


Figure 2-2. System Tape Format

LOADING THE EXEC

Use the following procedure to load the EXEC, starting from scratch. The procedure assumes you have the Protected Binary Cassette Loader in the protected area of memory and that you have a system tape with the format shown above.

- a. Insert the system tape cassette into Deck 1.
- b. Use the absolute tape loading procedure in Appendix A to load the System Loader (an absolute tape).
- c. After you've loaded the System Loader into core, set the P-Register of the computer to octal 0X7500. (In 2116 computers, set 0X7500 octal into the switch register and press LOAD ADDRESS.)  
X = 1 for 8K  
2 for 12K  
3 for 16K
- d. Press EXTERNAL PRESET and INTERNAL PRESET. (Press PRESET on 2116 computers).
- e. Press RUN.

The System Loader then rewinds the system tape in Deck 1 and loads the EXEC into core. The EXEC then responds with

EXEC>>

on the list device, and then waits for you to input another command. See Appendix B for the error halts for the System Loader.

Use the EXEC commands shown in Table 2-1 to control the Cassette Operating System.

Type in a command: the EXEC will perform the commanded operation and then print out

EXEC>>

to indicate completion of the operation. You may then enter another command.

Table 2-1. EXEC Commands

<b>CLEAR</b>	<p>General Form: CLEAR Example: CLEAR</p> <p>In a CRT-based system, CLEAR clears the screen; in other systems, the CLEAR command does nothing.</p>
<b>COMP</b>	<p>General Form: COMP <i>number of files</i> FROM <i>deck number</i> or COMP <i>number of files</i> or COMP FROM <i>deck number</i> or COMP</p> <p>Example: COMP 2 FROM 2</p> <p>COMP compares the specified number of files in the specified deck (1 or 2) with the same number of files in Deck 3. If you don't specify the deck number, the EXEC assumes the deck is 2. If you don't specify the number of files, the command compares one file. The comparison begins with the files currently positioned in the two decks. One use of COMP is to compare copied files.</p>
<b>COPY</b>	<p>General Form: COPY <i>number of files</i> FROM <i>deck number</i> or COPY FROM <i>deck number</i></p> <p>Example: COPY 1 FROM 2</p> <p>COPY copies the specified number of files from Deck 1 or 2 onto Deck 3.</p> <p>There are two special forms of the COPY command:</p> <p>COPY FROM <i>deck number</i> and COPY 0 FROM <i>deck number</i></p> <p>Both forms copy the currently positioned file in either Deck 1 or Deck 2 onto Deck 3 <i>without writing an end-of-file gap</i>. Not writing the end-of-file gap allows you to merge files. Remember, though, that you cannot compare (COMP) merged files.</p>
<b>DUMP</b>	<p>General Form: DUMP <i>file number</i> FROM <i>deck number</i> or DUMP <i>file number</i> or DUMP FROM <i>deck number</i></p> <p>Example: DUMP 3 FROM 3.</p> <p>DUMP outputs (in octal format) binary data from the specified deck and file to the display device.</p>

Table 2-1. EXEC Commands (cont'd)

**EXEC**

General Form: EXEC

Example: EXEC

The EXEC command instructs the System Loader to load the EXEC from File 2 of the system tape in Deck 1. The EXEC responds with EXEC>>; with the EXEC in control, you can use the SYST command to change the system tape now in Deck 1.

**FILE**General Form: FILE *file number* ON *deck number*

or

FILE ON *deck number*

Example: FILE 3 ON 2.

FILE outputs (in absolute format) a specified part of core memory to the specified file and deck. If you don't specify a file, the EXEC will output on the currently positioned file.

After you type in the command, the EXEC will ask you to input the first core location of the section to be filed.

FIRST CORE LOC?

Input the starting address in octal form. The EXEC then asks

LAST CORE LOC?

Input the address of the last word of the section you want to file; your answer must be in octal.

If you input an invalid octal number, the EXEC will respond

INVALID COMMAND

EXEC&gt;&gt;

You must retype the FILE command.

If your first core location is greater than the last, the EXEC will say

FIRST&gt;LAST

FIRST CORE LOC?

Give the new first core location.

After you've entered the FILE command, and the correct first and last core locations, the EXEC files the specified portion of core and then asks if you want to write an end-of-file gap now.

WEOF?

EXEC&gt;&gt;

To write an EOF gap see WEOF command in this table.

If you don't want to enter an EOF gap, enter any other command.

*Table 2-1. EXEC Commands (cont'd)*

## LIST

General Form: LIST *file number* FROM *deck number*  
or  
LIST FROM *deck number*  
or  
LIST *file number*  
or  
LIST

Example: LIST 2 FROM 3.

LIST outputs ASCII data from the specified deck and file to the display device.

If you don't specify the deck number, the EXEC will list from Deck 2; if you don't specify the file number, the EXEC will list from the currently positioned file in the specified deck.

The EXEC stops the listing when it sees an end-of-file gap or when you set switch 0 on the computer switch register.

## LOAD

General Form:      **LOAD** *file number* **FROM** *deck number*  
    **or**  
    **LOAD** *file number*  
    **or**  
    **LOAD**

**Example: LOAD 3 FROM 2.**

**LOAD** loads the specified file from the specified deck into core and executes the program in that file.

If you don't specify the deck, the EXEC will load from the default deck, Deck 2. If you don't specify the file, the EXEC will load from the currently positioned file on the specified deck.

To load a file into core, the EXEC calls the System Loader. There are restrictions on the kind of program the System Loader will load into core. Appendix B outlines the restrictions. FORTRAN and ALGOL programs processed by Cassette BCS automatically obey the restrictions.

**POS**

General Form: POS *file number* ON *deck number*  
or  
POS *file number*

**Example: POS 3 ON 2.**

POS positions the tape in the specified deck to the specified file. If you don't specify a deck, the EXEC selects the default deck, Deck 2.

After you type in the command, the EXEC rewinds the tape and then skips the appropriate number of files.

To avoid having to wait for the rewind, you might use the `SKIP` command instead of the `POS` command.

Table 2-1. EXEC Commands (cont'd)

**SKIP** General Form: SKIP *number of files* ON *deck number*  
or  
SKIP *number of files*

Example: SKIP 4.

SKIP skips the specified number of files (beginning with the currently positioned file) on the specified deck. If you don't specify the deck, the EXEC will select the default deck, Deck 2.

**SYST** General Form: SYST  
Example: SYST

The SYST command lists the names of the programs (except the System Loader and the EXEC) on the current system tape and begins the procedure for preparing a new system tape:

```

SYST
PROG NAME TABLE
.
.
list of program
names
.
.
CHANGE?

```

Press the BREAK key after the CHANGE? question if you want to stop the system tape preparation procedure and return to the EXEC.

If you do want to change the current system tape, refer to CREATING A NEW SYSTEM TAPE later in this section.

**WEOF** General Form: WEOF ON *deck number*  
Example: WEOF ON 3

WEOF writes an end-of-file gap and an end-of-file mark on the current file of the specified deck, effectively "closing" that file. End-of-file gaps separate files.

**WRITE** General Form: WRITE ON *deck number*  
Example: WRITE ON 3

The WRITE command enables you to write ASCII data on cassette tape from the keyboard. After you enter the command you may begin typing on the keyboard.

The Cassette Unit inputs (as a single record) each line terminated with a carriage return key.

To terminate writing, press the BREAK key\* on the control panel; the EXEC responds with:

```

WEOF?
EXEC>>

```

to remind you that you might want to write an end-of-file gap.

\*In teletype-based systems, press the CTRL and C keys together and then press carriage return.

## LOADING PROGRAMS FROM A SYSTEM TAPE

Any program may be loaded into core from tape by the LOAD command. You may load programs on a system tape more conveniently by typing the name of the program. The EXEC will search through its Program Name Table to find the location and then load it (through the System Loader) into core.

To position the system tape prior to loading the named program, the EXEC rewinds the tape and skips to the appropriate file.

If you don't know the names of the programs on the current system tape, type the SYST command; the EXEC will print out the program names.

## CREATING A NEW SYSTEM TAPE

You can create a new system tape by editing the current one. Editing includes adding, deleting or replacing programs.

The current system tape must be in Deck 1, a blank tape in Deck 3, and a program to be added (if any) in Deck 2.

To create a new system tape, type SYST; the EXEC will respond:

### PROG NAME TABLE

name 1  
name 2  
etc.

CHANGE?

The Program Name Table is a list of the names of the programs (other than the System Loader and the EXEC) on the system tape. The names are listed in the order in which they appear on the tape.

If you want to change the system tape, respond with one of the edit responses in Table 2-2 to edit your current system tape. You can return at any time to the EXEC, by pressing the BREAK key on the control panel.

If you're going to add a program, you'll have to give it a name. The name may be three or four letters long. However, the EXEC can distinguish only between the first three letters. For example, the EXEC cannot distinguish between FTN1 and FTN2, but it can distinguish between FTN and PS2 (for FORTRAN Compiler passes 1 and 2).

Example program names are: EDIT, ASMB, FTN, PS2, XREF, and CBCS.

Table 2-2. System Tape Edit Responses

Response*	Action
/C	Copy the system tape as is.
/D, old name	Delete the program "old name."
/I, old name new name	Insert program "new name" after program "old name" now on the system tape. You must have the "new name" program positioned in Deck 2 before you complete this edit response by typing the carriage return key.  Be sure to type the new name on the next line as shown.
/I new name	Insert the "new name" program immediately after the EXEC on the system tape. The "new name" program must be positioned in Deck 2 before you complete the edit response by typing the carriage return key.
/R, old name new name	Replace the "old name" program with the "new name" program. The "new name" program must be positioned in Deck 2 before you complete the edit response by typing the carriage return key.  Be sure to type the "new name" on the next line as shown.
*follow each response with carriage return.	

After any response except /C (which is executed immediately, without asking the GO? question), the EXEC makes the required change to its program name table. The EXEC then displays the new program name table and asks:

GO?

The EXEC is asking if you want to go ahead and actually make the edit you've typed in. The EXEC now in core has the new program name table).

If you don't want to perform the edit you've typed in, type N (for NO); the System Loader will then reload the EXEC.

If you do want to perform the edit, put a blank cassette into Deck 3 and the program to be added (if any) into Deck 2. Then type Y (for YES); the System Loader will copy the new (edited) system tape onto the cassette in Deck 3.

The EXEC in the Deck 3 cassette has a program name table for that system tape. If you intend to use the EXEC for any of its functions that depend on the configuration of the program name table (example: further edits), then you must put the new system tape into Deck 1.

If instead, you want to use the EXEC with the program name table it had for the old system tape, then leave the original system tape cassette in Deck 1 and type EXEC to reload the EXEC with the old program name table.

## CONFIGURING THE EXEC

The EXEC, which operates in the SIO environment, requires the System Loader, the keyboard-printer SIO driver (or the teleprinter SIO driver or the 8500A CRT SIO driver) and the Cassette Unit SIO driver.

Each SIO driver has a configuration section which reads the I/O channel number that you put into the computer switch register during the configuration procedure. Note that here *configuration* means telling the software which I/O channel to reference for each peripheral.

After the configuration section of a driver stores the I/O channel for the driver, the System Loader overlays the configuration section with the next SIO driver loaded. Since the SIO drivers are absolute programs, they must be loaded in proper order to avoid either wasting core or overlaying programs inadvertently.

SIO drivers reside in high core and are core-size dependent; the EXEC resides in low core and is core-size independent.

Use the following procedure to configure an EXEC.

1. Collect the absolute tapes for
  - the System Loader.
  - the keyboard-printer (or teleprinter or 8500A CRT) SIO driver.
  - the Cassette Unit SIO driver.
2. Load and configure the drivers in the following order:
  - System Loader.
  - Keyboard-printer (or teleprinter or 8500A CRT) SIO driver.
  - Cassette Unit SIO driver.

Load and configure each driver as shown in steps a through d.

- a. Use Protected Binary Cassette Loader procedure shown in Appendix A to load the driver into core.
- b. Display the P-Register on the computer: set it to 2 octal. (On the 2116 computer, set the switch register to 2 octal and press LOAD ADDRESS).
- c. Display the switch register on the computer and set it to the I/O channel number for the driver just loaded. (On the 2116, set the switch register to the I/O channel number).

The System Loader and the Cassette Unit SIO driver both use the I/O channel for the Cassette Unit.

- d. Press RUN.

When the driver is configured, the computer will halt with 102077 octal displayed in the MEMORY DATA REGISTER.

Go to step a to load the next driver, or go to step 3 if you've loaded and configured all the drivers.

3. Use Protected Binary Cassette Loader procedure (Appendix A) to load the absolute unconfigured EXEC.
4. Display the P-Register and set it to 100 octal (for the 2116, set the switch register to 100 octal and press LOAD ADDRESS). Press RUN.

The printer will output: EXEC>>.

5. Type the command: SYST

6. The System Loader will print out

PROG NAME TABLE  
CHANGE?

7. Put a blank cassette in Deck 3 and type /C.

The system then writes (on Deck 3) a system tape with a configured EXEC and prints out EXEC>> to show that the writing has been completed. You may now remove the cassette from Deck 3.

The System Loader is in File 1; File 2 contains the EXEC and its configured SIO drivers.

## EXEC ERROR MESSAGES

Table 2-3 shows the error messages that the EXEC may print out. Refer to Appendix C for any other error messages.

Table 2-3. EXEC Error Messages

Message	Action
INVALID COMMAND	After printing the message, the system will print EXEC>> and wait for you to type another command.
DK # ERR	A command contains an invalid deck number for the operation specified. The system returns to the EXEC>> statement.
COMP ERR, DUMP?	Answer with Y to dump first the record on Deck 1 or 2 and then the record on Deck 3. Any other answer returns program control to the EXEC.
DK # EOF	This is not an error message. It indicates that the Cassette Unit encountered an end-of-file gap, which is normal with the use of many EXEC commands. The end-of-file gap was encountered on the deck specified.
FIRST>LAST	You've used the FILE command, but you answered the first and last core location questions with a first location greater than the last location. The EXEC repeats the FIRST CORE LOCATION question; answer with the correct number.
ERROR	There is a hardware malfunction. The system prints out the EXEC>> statement.
WEOF?	This is not an error message, but a reminder that you may want to write an end-of-file gap now.

## SECTION III

### CASSETTE ALGOL

#### GENERAL INFORMATION

**Cassette I/O in an ALGOL Program** See the "I/O for a Cassette FORTRAN Program" discussion in Section VI.

**Compiler Description** The Cassette ALGOL Compiler is the SIO program that provides compiling capability in the cassette operating environment. The Compiler reads the source files to-be-compiled from Deck 2, and writes the resulting relocatable object file on Deck 3.

**References** For a general description of the ALGOL language, the ALGOL Compiler and its error messages, refer to the HP ALGOL manual (02116-9072). Keep in mind, though, that Deck 2 replaces the photoreader, Deck 3 replaces the paper-tape punch, and that messages on the list device have replaced all computer halts.

**BREAK Option** At any time during execution of the Cassette ALGOL Compiler, you may interrupt its operation by pressing the BREAK button. The Compiler transfers control to the RESTART? question which gives you the option to restart the compiler or return control to the EXEC.

The BREAK option is not available with teleprinter systems.

**PROGRAMMING INFORMATION** See the Cassette FORTRAN PROGRAMMING INFORMATION discussion in Section VI.

#### COMPILATION PROCEDURE

To prepare the cassette unit for an ALGOL compilation, insert in:

- |        |   |  |
|--------|---|--|
| Deck 1 | — | a system tape with the Cassette ALGOL Compiler on it.          |
| Deck 2 | — | the source tape or tapes to be compiled.                       |
| Deck 3 | — | the tape on which the relocatable object file is to be output. |

Use the EXEC to load the ALGOL Compiler from the system tape.

The Cassette ALGOL Compiler operating procedures differ from those of the HP ALGOL Compiler in that the Cassette Compiler

- requests source file number.
- requests additional source files.
- announces end of compilation.
- provides a restart capability.

In the following discussions, operator inputs are underlined.

SOURCE FILE # ?

1

The compiler asks for the file number (a decimal number) of the source program to be compiled. The source program should be in Deck 2. Valid responses are 1 through 9. The compiler ignores invalid responses and asks the question again.

If the source program is on more than one file, answer with the first file.

After you answer the question, the compiler rewinds Deck 2 and positions the tape to the specified file. Execution begins automatically.

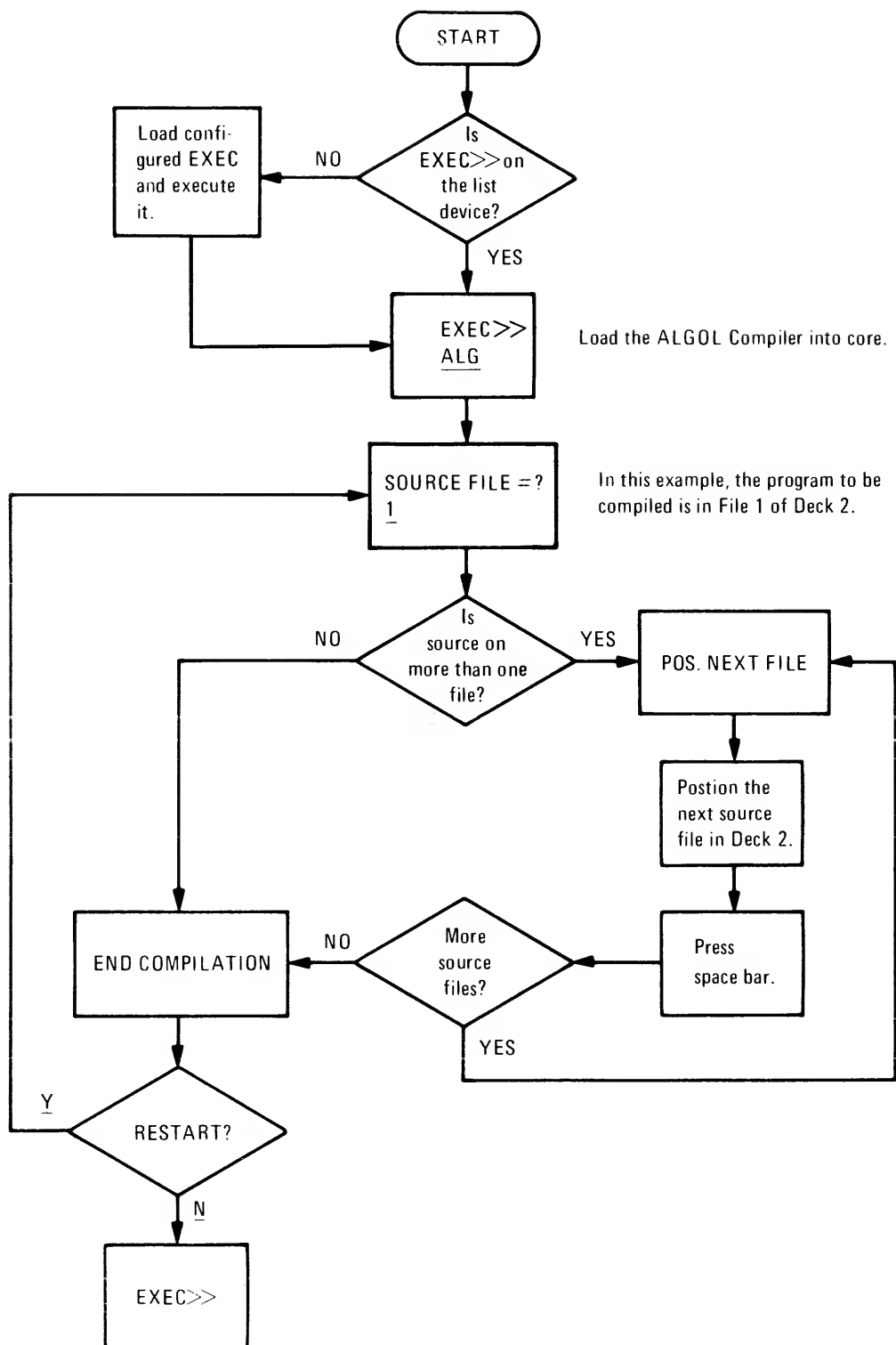


Figure 3-1. Cassette ALGOL Compilation

If the compiler encounters an end-of-file gap before an END\$ statement, the compiler will print out

POS. NEXT FILE

Position the tape to the beginning of the next file for the source program to be compiled. Then press the space bar and the carriage return key.

After the compilation is complete, the compiler will print out

END COMPILATION  
RESTART?  
Y

(The RESTART? question may also be entered by pressing the BREAK button). Respond with either Y (for yes) or N (for no.)

Y — to restart Cassette ALGOL Compiler execution.  
N — to return control to the EXEC.

Table 3-1. Cassette ALGOL Messages

Message	Explanation	Action
END COMPILATION	You've successfully completed the ALGOL compilation.	None.
POS. NEXT FILE	The Compiler has encountered an end-of-file before the end of program, indicating that the source is on more than one file.	Position the cassette in Deck 2 to the start of the next source file. Press the space bar to continue.
RESTART?	The execution of the Compiler has stopped.	Type Y to restart the compiler, or N to return to the EXEC.
REWIND ERR	Hardware error; no leader detected after rewind.	Manually rewind the deck; press the space bar to continue.
SOURCE FILE FILE #?	This is a request for the file number of the source to be compiled.	Type the decimal file number.
Refer to the Cassette SIO Driver Error Messages in Appendix C for any other messages which may appear during the compilation procedure.		

```

EXEC>>
ALG
SOURCE FILE #?
1
PAGE 001

001 02000 HPAL,L,B,"DUP"
002 02000      BEGIN
003 02003      FORMAT F1 ("USER INSTRUCTIONS?←"),
004 02020          F2("INPUT UNIT?←"),
005 02030          F3("OUTPUT UNIT?←"),
006 02041          F4("ASCII?←"),
007 02047          F5("# OF FILES?←"),
008 02057          F6("MORE?←"),
009 02064          F7(A1),
010 02066          F8("LIST?←"),
011 02074          F10("INPUT UNIT:"/" 7=DICOM DECK 1"/
012 02114          " 8=DICOM DECK 2"/" 9=DICOM DECK 3"/
013 02136          "10=PHOTO READER"/"11=CARD READER"/
014 02157          "12=TTY"/
015 02164          "OUTPUT UNIT:"/" 7=DICOM DECK 1"/
016 02205          " 8=DICOM DECK 2"/" 9=DICOM DECK 3"/
017 02227          "12=TTY"/"13=LINE PRINTER"/"14=PUNCH"/);
018 02253      INTEGER I,J,K,FILES,RTYPE,IUNIT,OUNIT;
019 02253      LABEL LOOP;
020 02254      LABEL FIN;
021 02255  PROCEDURE COPY(IUNIT,OUNIT,LFLAG,RTYPE);
022 02256      INTEGER IUNIT,OUNIT,RTYPE,LFLAG;
023 02256      CODE;
024 02255      INTEGER LFLAG;
025 02255      WRITE(2,F1); READ(1,F7,I); IF I="Y" THEN WRITE(2,F10);
026 02304  LOOP:  WRITE(2,F2); READ(1,*,IUNIT);
027 02321      WRITE(2,F3); READ(1,*,OUNIT);
028 02336      IF OUNIT=13 THEN BEGIN
029 02342          LFLAG ← 1; RTYPE ← OUNIT ← 0;
030 02347          GO TO FIN; END;
031 02350      IF IUNIT=11 THEN BEGIN
032 02354          RTYPE ← 0; WRITE (2,F8); READ (1,F7, LFLAG);
033 02373          IF LFLAG # "Y" THEN LFLAG ← 0; GO TO FIN; END;
034 02402      WRITE(2,F4); READ(1,F7,I); IF I="Y" THEN BEGIN
035 02423          WRITE(2,F8); READ(1,F7,LFLAG);
036 02440          IF LFLAG # "Y" THEN LFLAG ← 0; RTYPE ← 0;
037 02450      END ELSE BEGIN RTYPE ← 1; LFLAG ← 0; END;
038 02455  FIN:
039 02455      WRITE (2,F5); READ(1,*,FILES);
040 02472      FOR I←1 STEP 1 UNTIL FILES DO COPY(IUNIT,OUNIT,LFLAG,RTYPE);
041 02522      WRITE(2,F6); READ(1,F7,1); IF I="Y" THEN GO TO LOOP;
042 02544      IF I="C" THEN GO TO FIN;
043 02551  ENDS

PROGRAM=000552  BASE PAGE= 000022  ERRORS= 000
END COMPILEATION

RESTART?
N
EXEC>>

```

Figure 3-2. Example ALGOL Compilation Printout

## SECTION IV

### CASSETTE ASSEMBLER

#### GENERAL INFORMATION

##### Description

The Cassette Assembler is an SIO program that provides assembling capability for the cassette operating system. The Assembler reads the source programs to be assembled from Deck 2, and writes the output binary file on Deck 3.

##### Operation

If the source program is contained all on one file, the Cassette Assembler operates as a one-pass assembler. The Assembler automatically performs the second pass by rewinding the cassette in Deck 2, repositioning it to the start of the original source program, and then executing. It is essential that you not inadvertently remove cassettes during the assembly process.

##### Cross Reference Capability

Given a system tape on which the Cassette Cross Reference Table Generator is in the file after the Cassette Assembler, you can call for a cross reference table of your assembled program by including a "C" in the assembly language control statement for the program:

ASMB, B, L, R, C

##### References

For a general description of ASSEMBLY language, the Assembler and its error messages, refer to the HP Assembler Manual (02116-9014). Keep in mind that Deck 2 replaces the photoreader, Deck 3 replaces the punch, and all halts have been replaced by messages on the list device.

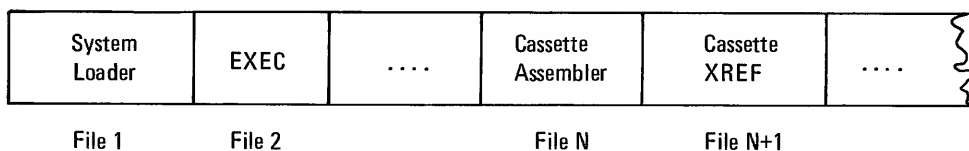
##### BREAK Option

At any time during execution of the Cassette Assembler, you may interrupt its operation by pressing the BREAK button. The Assembler then goes to the RESTART? question which gives you the option of either restarting the Assembler, or returning program control to the EXEC. This option is not available on teleprinter-based systems.

#### SYSTEM TAPE ORGANIZATION

If you're using the ASSEMBLER without the Cross Reference Table Generator, there are no special requirements placed on the organization of the system tape containing the ASSEMBLER.

If, however, you are using the Cassette XREF with the ASSEMBLER, then the Cassette XREF must be in the file immediately after the ASSEMBLER as shown below.



*Figure 4-1. Assembler System Tape Organization*

#### OPERATING PROCEDURES

To prepare the Cassette Unit, insert in

- Deck 1 — a system tape with the Cassette Assembler on it.
- Deck 2 — the source tape(s) to be assembled.
- Deck 3 — the tape onto which the binary object program is to be output.

Use the EXEC to load the Assembler. Once you've loaded it, the Cassette Assembler differs from the HP Assembler in that the Cassette Assembler

- requests a source file number.
- asks for location of the source program's control statement.
- allows you to correct a control statement error.
- asks for additional source files, if any.
- lists notice of termination of Pass I and Pass II.
- provides a restart capability.

After you load the Assembler, the first question it asks is:

```
SOURCE FILE #?
1
```

The Assembler asks for the file number of the first source program on the cassette in Deck 2. Valid responses are between 1 and 9. The Assembler ignores invalid responses, but asks the SOURCE FILE #? question again. In the example above, the source program is in File 1.

If the source program is on more than one file, answer with the number of the first file.

The Assembler rewinds the cassette and positions the tape to the beginning of the specified file.

Next, the Assembler asks if the control statement is on the source program or if you will enter the statement via the keyboard during assembly time: In the following example, the control statement is on the source program:

```
C.S. ON SOURCE?
Y
```

Answer N if you will enter the control statement during the assembly process. If you type N, the Assembler will print

```
ENTER C.S.
ASMB, B, L, R, C
```

Type in the control statement for your source program.

If the Assembler detects an error in the control statement, the list device prints out

```
CS ERR
```

If you entered the control statement via the keyboard, press the space bar to restart the Assembler. If the control statement is on the source program, you have two options:

- a. Press the space bar to restart execution of the Assembler; this way you can try reading the control statement again.
- b. Press the BREAK button and answer the RESTART? question with N. Program control now returns to the EXEC. List and edit the incorrect source file.

If there is no control statement error, the Assembler next asks you to position the next file of the source program if there is more than one file. The Assembler prints out the statement below if it sees an end-of-file before an END statement.

```
POS NEXT FILE
```

Position the tape in Deck 2 to the start of the next file of the source program; then press the space bar.

If the source program consists of more than one file, Pass 1 of the Assembler will process the source program; the Assembler then prints out

END PASS

To go to Pass 2, position the Deck 2 tape to the beginning of the first source file and press the space bar.

If the original source program was on one file, the Assembler would go directly from Pass 1 to Pass 2 after automatically rewinding the Deck 2 cassette and positioning the tape to the beginning of the source tape file. After completing Pass 2, the Assembler outputs

\*END ASMB

No action is required from you.

If you had asked for cross reference, and the source program had been on one file, the Assembler will automatically position the Deck 2 tape to the beginning of the source program and pass control to the Cassette Cross Reference Table Generator.

If you asked for cross reference and the source program was *not* contained in one file, the Assembler would print out

END PASS

Position the Deck 2 tape to the beginning of the first source program file and press the space bar.

If you did not use the Cassette Cross Reference Table Generator capability, the Assembler will print out the following after it completes its operation:

RESTART?

Y

The RESTART? question gives you two options:

- Y — if you want to restart the execution of the Cassette Assembler.
- N — if you want to return program control to the EXEC.

You may also enter the RESTART? question by pressing the BREAK key.

```

                                ORG 115B
                                LDA PRNTS
                                STA COUNT
COUNT BSS 1
START  LDA LNGLH
                                LDB BUFF
                                JSB 102B,I
                                ISZ COUNT

                                JMP START
                                HLT 15B
                                DEF MSG
BUFF   OCT 14
LNGLH  OCT 14
PRNTS  DEC -10
MSG    ASC 6,TEST OUTPUT
                                END COUNT

EXEC >>>
ASMB Here the operator calls the Assembler from the system tape.

Pass I
printout and
operator input
SOURCE FILE #?
1
C.S. ON SOURCE?
N Operator says he will enter the source program's control
statement now from the keyboard.
ENTER C.S.
ASMB,B,L,A
PAGE 0001

0001 ASMB,B,L,A
DK 2 EOF Simply states that the EXEC read the file and detected
POS. NEXT FILE the end-of-file.

** NO ERRORS *

END PASS End of Pass I: operator rewinds tape in Deck 2 to
Pass II position to File 1. Press the space bar to continue.

PAGE 0002 #01

0001 00115 ORG 115B
0002 00115 060130 LDA PRNTS
0003 00116 070117 STA COUNT
0004 00117 000000 COUNT BSS 1
0005 00120 060127 START LDA LNGLH
0006 00121 064126 LDB BUFF
0007 00122 114102 JSB 102B,I
0008 00123 034117 ISZ COUNT
DK 2 EOF
POS. NEXT FILE File 2 is already positioned: press the space bar
to continue.

0001 00124 024120 JMP START
0002 00125 102015 HLT 15B

```

Figure 4-2. Assembler Operating Procedure Example Printout

```

0003 00126 000131      BUFF  DEF  MSG
0004 00127 000014      LENGTH OCT  14
0005 00130 177766      PRNTS  DEC -10
0006 00131 052105      MSG    ASC  6,TEST  OUTPUT
      00132 051524
      00133 020117
      00134 052524
      00135 050125
      00136 052040
0007                                END  COUNT
**      NO ERRORS*

*END ASMB                          Indicates successful completion of the
                                     Assembly process.

RESTART?
Y                                In this example, the operator wants to
                                     restart operation of the Assembler.

SOURCE FILE #?
      .
      .
      etc.
      .
      .

```

*Figure 4-2. Assembler Operating Procedure Example Printout (cont'd)*

```

00010000 000115 060130 070117 150364ER
007400   000120 060127 064126 114102 034117 024120 102015
000131   000014 177766 052105 051524 020117 052524 050125
052040   003767ER

```

*Figure 4-3. Dump of Binary File Produced (on Deck 3)*

Table 4-1. Assembler Messages\*

Message	Explanation	Action
CS ERR	There's an error in the control statement.	Press the space bar to restart the Cassette Assembler or press the BREAK button to bailout of the ASSEMBLER.
C.S. ON SOURCE	Assembler is asking for location of the control statement for the source program.	Type Y if the control statement is on the source program. Type N if you will enter the control statement from the keyboard.
*END ASMB	Successful completion of the ASSEMBLER procedure.	None.
END PASS	Indicates that the current pass is complete, and that the source program is on more than one file.	Position the tape in Deck 2 to the beginning of the first source file; press the space bar.
ENTER C.S.	The control statement for the current source program must be entered from the keyboard.	Enter the control statement from the keyboard.
POS. NEXT FILE	The ASSEMBLER encountered an end-of-file before the end of the source program, which indicates that the source program is on more than one file.	Position the tape in Deck 2 to the beginning of the next source file; press the space bar.
RESTART?	Execution of the Cassette ASSEMBLER has stopped.	Type Y to restart the ASSEMBLER or N to return to the EXEC.
REWIND ERR	A hardware error: no leader detected after rewind.	Manually rewind the deck; press the space bar to continue.
SOURCE FILE #	Request for the file no. of the source to be assembled.	Type the decimal file no.
*Refer to the Cassette SIO Driver Error Messages in Appendix C for any other messages that may appear during the compilation procedures.		

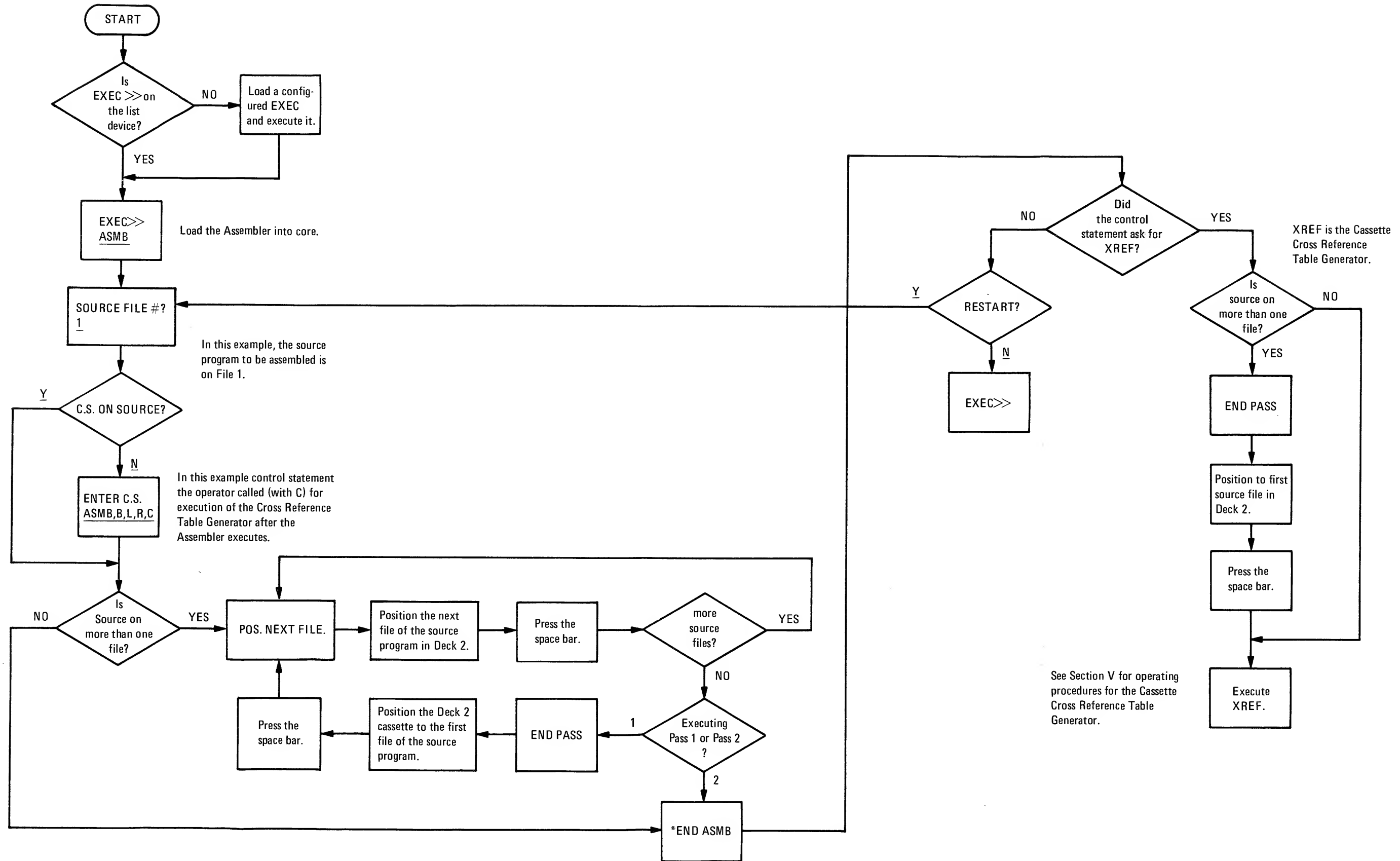


Figure 4-4. Assembler Operating Procedures Flowchart

## SECTION V

### CASSETTE CROSS REFERENCE TABLE GENERATOR (XREF)

#### GENERAL INFORMATION

##### Description

The Cassette Cross Reference Table Generator (XREF) is the SIO program that provides the user with cross reference capabilities in the cassette operating system. XREF reads source files from the cassette(s) in Deck 2 and outputs the cross reference table to the list device.

##### Execution Environments

XREF may be used with the Cassette Assembler or independently. If you're using the XREF with the Cassette Assembler, the system tape that holds both of the programs must be organized as shown in Figure 4-1. The "C" in the ASSEMBLY language source program control statement automatically calls XREF. When you're using the XREF with the Cassette Assembler, be sure not to remove cassettes during execution of the Assembler.

##### References

For a general description of the Cross Reference Table Generator, refer to the Operator's Guide (Manual Part No. 02116-9057). Keep in mind, though, that the photoreader has been replaced by Deck 2. All computer halts have been replaced by messages displayed on the list device.

##### BREAK Option

At any time during execution of XREF, you may interrupt its operation by pressing the BREAK button. The XREF then asks RESTART? to give you the option of restarting XREF or of returning control to the EXEC. This option isn't available with teleprinter-based systems.

#### OPERATING PROCEDURES

No preparation is necessary if the Assembler has called XREF from the system tape. Leave the cassettes in Deck 1 and Deck 2 as they were at the end of the ASSEMBLY process.

If you're executing the XREF as an independent program, prepare the cassette unit by inserting in

Deck 1 — a system tape with the XREF on it.

Deck 2 — the source tape for which a cross reference table is to be generated.

Execution of XREF proceeds as follows. The first question the XREF asks is

SOURCE FILE #?

1

The question asks for the file number (decimal) of the source program in Deck 2. Valid responses are 1 to 9. In the example above the source program was in file number 1. XREF ignores invalid answers and asks the question again.

If the source program is on more than one file, answer with the number of the first file. XREF will rewind Deck 2 and position the tape to the beginning of the file you specified.

Note that the SOURCE FILE#? question will not appear when you're using the Assembler to automatically call the XREF off the system tape, since the tape should already be properly positioned even before execution of the Assembler stops.

A source program may be on more than one file; if that's true for your source program, XREF will detect an end-of-file before the end of the program and then print out

POS. NEXT FILE

Position the tape in Deck 2 to the start of the next file of the source program. Then press the space bar to continue execution.

Completion of the XREF procedure produces this message:

```
RESTART?
N
```

Pressing the BREAK button will also produce the RESTART? question. Answer with

```
Y  - to restart execution of XREF.
N  - to return control to the EXEC.
```

## SYSTEM TAPE ORGANIZATION

If you're not having the Assembler call the XREF from the system tape, there are no special requirements placed on the organization of the system tape containing the XREF.

However, if you are using the Assembler with the XREF, then XREF must be in the file immediately following the Assembler as shown below.

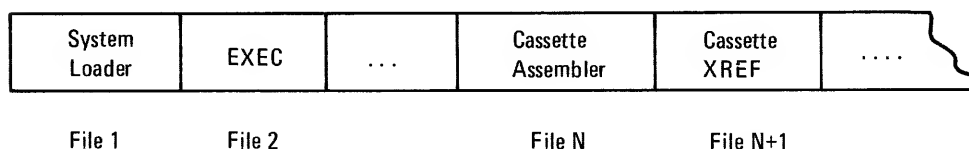


Figure 5-1. XREF System Tape Organization

Table 5-1. Cassette Cross Reference Table Generator Messages

Message	Explanation	Action
POS. NEXT FILE	The source program is on more than file.	Position the tape in Deck 2 to the start of the next file of the source program. Press the space bar.
RESTART?	Execution of XREF has stopped.	Type: Y to restart the XREF. N to return control to the EXEC.
REWIND ERR	A hardware error: no leader detected after rewind.	Manually rewind the deck. Press the space bar to continue.
SOURCE FILE #?	Asking for the file number of the source program for which the table will be made.	Type the file number (decimal).
Refer to the Cassette SIO Driver Error Messages in Appendix C for other messages that might occur during execution of XREF.		

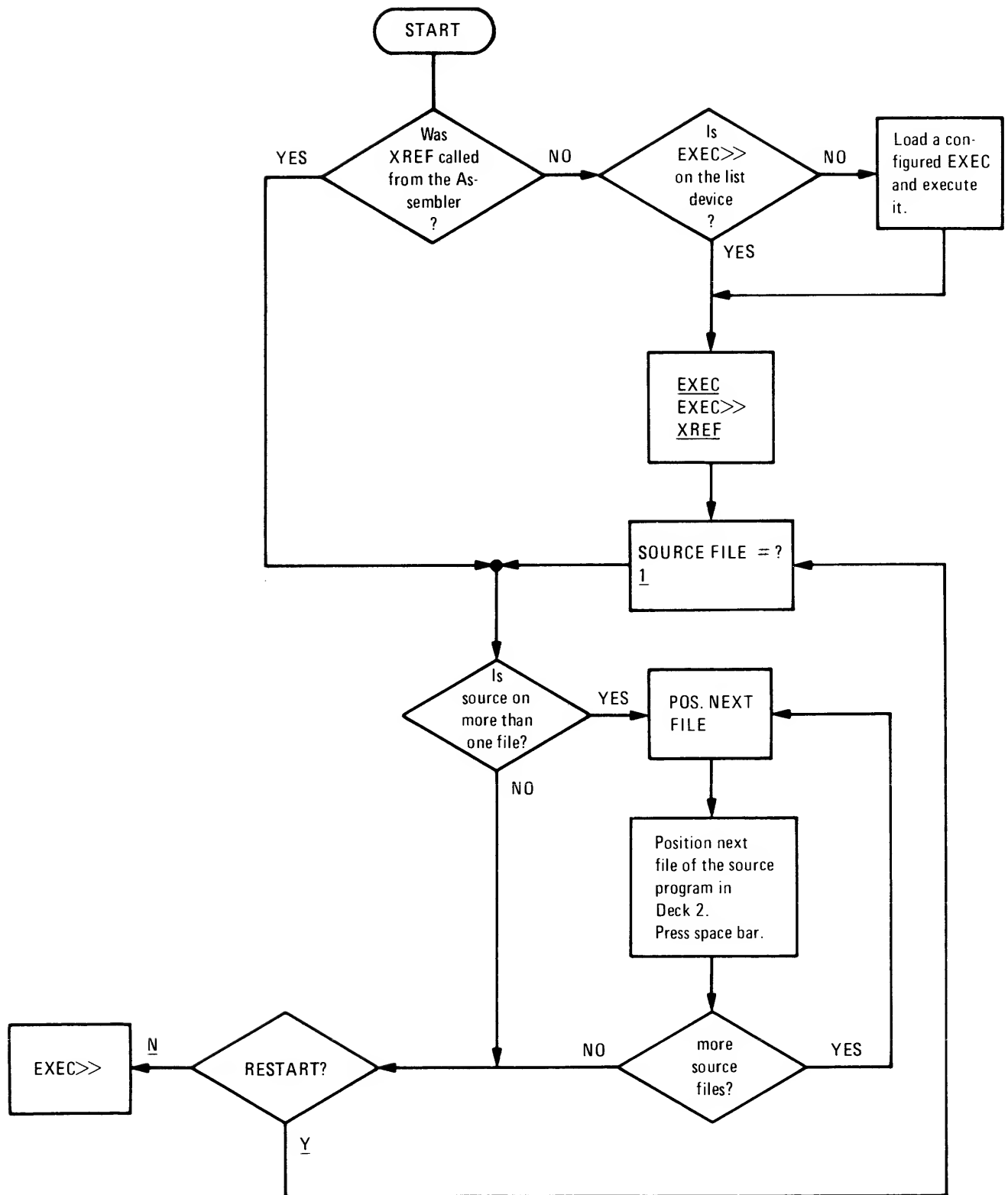


Figure 5-2. XREF Operating Procedures Flowgraph

## SECTION VI

### CASSETTE FORTRAN

#### GENERAL INFORMATION

This section contains both programming information and compilation procedures needed to use FORTRAN in the cassette environment.

The instruction set of Cassette FORTRAN is the same as for standard HP FORTRAN II, except that Cassette FORTRAN interprets magnetic tape calls and functions (for example REWIND and CALL PTAPE) as calls and functions for the Cassette Unit. However, the compilation procedures of Cassette FORTRAN are different from the standard HP FORTRAN II procedures; the procedures for Cassette FORTRAN are described later in this section.

#### PROGRAMMING INFORMATION I/O for a Cassette FORTRAN Program

Cassette FORTRAN allows you to read or write data on any of the three cassette unit decks. FORTRAN selects a deck by the unit reference number that appears in the FORTRAN statement; for example,

READ (5, 110) A, B, C

reads data from Unit 5, which is normally configured to be Deck 2.

FORTRAN is configured for the three decks during the BCS processing. The standard configuration for the three decks is:

Deck#	Unit Reference #	Device
1	3	Input for FORTRAN Library Standard input Standard output
2	5	
3	4	

If you want to change the configuration, change the SQT entries during BCS. Refer to the discussion of SQT entries in the BCS section.

#### Accessing the Cassettes

In a FORTRAN or ALGOL program, you may access any of the cassettes in one of three ways:

- a. I/O statements
- b. CALL statements
- c. Functions.

Each is discussed below.

#### I/O Statements

**READ Statements.** A READ statement inputs at least one record from the specified cassette. The Formatter limits the record size to 60 words.

An example of a *formatted* READ statement follows:

READ (5, 110) A, B, C  
110 FORMAT (3E10.6)

FORTRAN reads the values for the argument list according to the format specified. A “/” in the format statement initiates reading of a new record.

An example of an *unformatted* READ statement follows:

READ (5) X, Y, Z

In this example FORTRAN reads the values from the tape in binary format.

**WRITE Statements.** A WRITE statement outputs at least one record to the specified tape. The Formatter limits the record size to 60 words.

An example of a *formatted* WRITE statement follows:

```

      WRITE (4,200) A, B, C
200  FORMAT (3E10.6)

```

FORTTRAN writes the values of the argument list according to the format specified. A “/” initiates writing of a new record. The Cassette Unit will write a null record if you do either of these:

- make the last element of a FORMAT statement a / as in this example:

```
200 FORMAT (3E10.6/)
```

- put two / together in a FORMAT statement, as in this example:

```
200 FORMAT (3E10.6//3E10.7)
```

The Cassette Unit writes a “null record” as line feed followed by a carriage return.

Software operating in the BCS environment ignores null records.

Software (such as the EXEC) operating in the SIO environment interprets a null record as an end-of-file indicator.

So, if you want to provide line spacing for data that will be used by the EXEC (or any other SIO environment program), be sure to follow each / with a space wrapped in quotes. Here’s an example:

```
200 FORMAT (3E10.6/" "/3E10.7)
```

Here’s an example that double spaces:

```

Wrong: 200 FORMAT (3E10.6//)
Right: 200 FORMAT (3E10.6/" "/"/" ")

```

An example of an *unformatted* WRITE statement follows:

```
WRITE (4) X, Y, Z
```

FORTTRAN writes the values of the argument list on the cassette in binary form.

**REWIND Statements.** The REWIND statement rewinds the tape in the cassette specified by the unit reference number *u* as shown below:

```
REWIND u
```

**ENDFILE Statements.** The ENDFILE statement writes an end-of-file mark on the cassette specified by the unit reference number *u* as shown below:

```
ENDFILE u
```

## Call Statements

The CALL statements available specifically for the cassette operating system are discussed below.

CALL CLEAR issues a clear request to the specified unit.

CALL CLEAR (*u*) where *u* is the unit reference number.

CALL PTAPE forward-positions the tape in the specified deck.

CALL PTAPE (*u*, *f*, *r*)

where *u* is the unit reference number.

*f* is the positive integer that specifies the number of *files* to be positioned forward.

*r* is a positive integer specifying the number of *records* to be positioned forward.

CALL BFINP (*u*, *a*, *b*) inputs into buffer *a* from the specified deck.

CALL BFINP (u, a, b)

where u is the unit reference number.  
 a is the buffer address.  
 b is the length of the buffer; b is positive for words and negative for characters.

CALL BFOUT (u, a, b) outputs to the specified deck from buffer a.

CALL BFOUT (u, a, b)

where u is the unit reference number  
 a is the buffer address  
 b is the length of the buffer; b is positive for words and negative for characters.

## Functions

The functions that are available exclusively for Cassette FORTRAN are described in Table 6-1.

*Table 6-1. Cassette FORTRAN Functions*

Function	Description
IEOF (u)*	Function value is negative if an end-of-file is encountered during the last tape operation on the logical unit specified.
IERR (u)	Function value is negative if a read/write error has occurred on the specified unit.
IEOT (u)	Function value is negative if an end-of-tape was encountered during the last forward movement of the specified unit.
ISOT (u)	Function value is negative if the leader oxide is under the tape head of the specified unit.
LOCAL (u)	Function value is negative if the specified unit is OFF-LINE or not ready.
IWRDS (u)	Function value is the positive number of characters input or output during the last READ or WRITE operation on the specified unit.
IUNIT (u)	Function value is negative if the specified unit is busy; if the specified unit is 0, the IUNIT routine returns the system status. A positive function value indicates all units in the system are ready.
*u is the unit reference number of the deck referred to.	

## COMPILATION PROCEDURES

### Compiler Description

The Cassette FORTRAN Compiler is the SIO program that provides the compiling capability for the cassette operating system. The Compiler reads source files to be compiled from the cassette (or cassettes, if the program is long) in Deck 2, and writes on Deck 3 the relocatable object file produced.

### Compiler Operation

The Compiler itself is on two files: Pass 1 (FTN) on one file, and Pass 2 (PS2) on the next file. Pass 2 must immediately follow Pass 1 on the system tape.

The Cassette FORTRAN Compiler operates as a one-pass compiler. Pass 1 writes the intermediate tape on the file immediately following Pass 2 on the system tape in Deck 1.

Pass 1 completes execution and then passes control automatically to Pass 2. Pass 2 reads the intermediate file from Deck 1, and outputs the final relocatable object file to the tape in Deck 3.

## References

For a general description of the FORTRAN language, the FORTRAN Compiler and its error messages, refer to the HP FORTRAN II Manual (02116-9015). Keep in mind that Deck 2 replaces the photoreader, Deck 3 replaces the punch, and messages on the list device have replaced all computer halts.

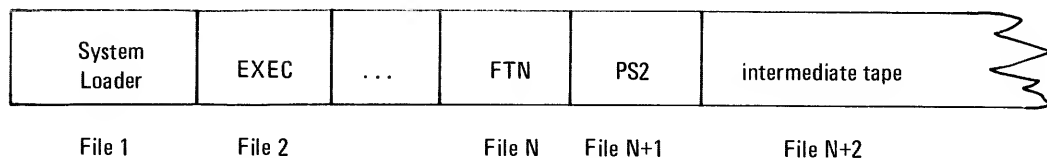
## BREAK Option

At any time during execution of the Cassette FORTRAN Compiler (Pass 1 or Pass 2) you can interrupt by pressing the BREAK button. The Compiler then asks RESTART? to give you the option of restarting the compiler to the start of Pass 1, or of returning to the EXEC. This option is not available to teleprinter-based systems.

There are three restrictions on the system tape that contains the FORTRAN Compiler:

- a. Compiler Pass 2 must be in the file immediately behind the file that contains Pass 1 (FTN).
- b. Pass 2 must be the last file on the system tape in Deck 1; the reason is that the section of tape after Pass 2 is where the Compiler will write the intermediate tape.
- c. Since the Compiler (FTN) will write the intermediate tape on the system tape, be sure that the cassette containing the system tape does not have the write-protect tab broken.

Figure 6-1 shows the structure of the system tape containing the Compiler.



*Figure 6-1. System Tape with FORTRAN Compiler*

## Preparation

To prepare the Cassette Unit for FORTRAN compilation, insert in

- Deck 1 — a system tape with Cassette FORTRAN Compiler Pass I (FTN) and Pass II (PS2) on it.
- Deck 2 — the source tape or tapes.
- Deck 3 — a blank tape onto which the Compiler will output the relocatable object file.

Use the EXEC to load the Compiler. The operating procedures for the Cassette FORTRAN Compiler differ from the procedures for the HP FORTRAN Compiler in that the Cassette FORTRAN Compiler

- checks for a valid system tape.
- requests a source file number.
- asks for the location of the control statement for the source program.
- asks if there are more source files than the one already processed.

**Operating  
Procedures**

- issues error messages instead of halts.
- automatically terminates at the end of Pass 2.
- provides an option of restarting the Compiler or returning to the EXEC.

Since the Compiler will write the intermediate tape on the Deck 1 cassette, it's vital that the Deck 1 cassette have blank tape where the Compiler expects it to be.

After you load it, the Compiler checks to see if the system tape in Deck 1 is correctly positioned. Since Pass I (FTN) has just been loaded, the tape should be positioned between Pass I and Pass II. The Compiler checks for clear leader; if the Compiler sees clear leader, then the tape has been inadvertently rewound. If the Compiler doesn't see clear leader, it assumes that the tape is correctly positioned. It's up to you to make sure the tape is correctly structured to begin with. If clear leader is detected, the Compiler asks

FORTRAN SYSTEM TAPE?

Y

Answer with Y or N:

- Y — if the system tape in Deck 1 contains the Compiler *and* if you want to continue with the compilation. After you answer Y, the Compiler positions the tape to the beginning of the intermediate tape file if necessary.
- N — if you don't want to continue further execution of the Compiler. The Compiler returns program control to the EXEC.

The next question the Compiler asks is

SOURCE FILE #?

3

It asks for the decimal file number of the source program (in Deck 2) to be compiled. Valid responses are 1 — 9. If the source is one more than one file, answer with the first file. After you answer, the Compiler rewinds the tape in Deck 2 and positions it to the beginning of the specified file and proceeds automatically.

The next question is

C. S. ON SOURCE?

N

The control statement for the source program to be compiled may be either on the source program or you may enter it from the keyboard at this time. Respond with Y or N:

- Y — if the control statement is on the source program.
- N — if you intend to enter the control statement from the keyboard.

If you typed N, the Compiler prints out

ENTER C. S.  
FTN, B, L

The Compiler asks you to enter the control statement now.

If the source program is on more than one file, the Compiler will ask you to position

the next file.\*

POS. NEXT FILE

Position the tape in Deck 2 to the beginning of the next file of the source program and then press the space bar.

Execution of the compiler proceeds automatically: when operation is complete, the Compiler prints out

END COMPILATION

After the END COMPILATION statement, the Compiler prints out

RESTART?  
Y

(Pressing the BREAK button will also produce the RESTART? question). Answer with Y or N:

- Y — to restart execution of the Compiler.
- N — to return control to the EXEC.

**OBJECT PROGRAM EXECUTION MESSAGES** During execution of the object program produced during compilation, either of the messages shown in Table 6-2 may be output on the list device.

Table 6-2. Object Program Execution Messages

Message	Explanation	Action
*EQR	Equipment error: the A-register contains the guilty unit reference number. If the cassette unit, it may be either a read/write error or unexpected end of tape.	If a cassette error, inspect contents of B register. Bit 1 on is a read error; 4 is a write error; 5 is end of tape.
STOP RE-START?	Execution of the object program is successfully complete.	Type: <u>Y</u> to restart the object program. <u>N</u> to return control to the EXEC.

**CASSETTE FORTRAN MESSAGES**

Table 6-3 describes the messages that are unique to Cassette FORTRAN.

\*The Compiler assumes there is more than one file for the source program when it encounters an end-of-file before the ENDS statement.

Table 6-3. Cassette FORTRAN Messages

Message	Pass	Explanation	Action
CHECKSUM ERROR RESTART?	2	The Compiler encountered a Checksum error while reading the intermediate tape.	Type: <u>Y</u> to restart execution of Pass I. <u>N</u> to return control to the EXEC.
C.S. ON SOURCE?	1	The Compiler asks for the location of the control statement for the source program.	Type: <u>Y</u> if the control statement is on the source program. <u>N</u> if you will enter the C.S. from the keyboard.
END COMPI- LATION	2	The Compiler has successfully completed execution.	None.
ENTER C.S.	1	This question is fallout from the C.S. ON SOURCE question.	Type the control statement for the source program now positioned in Deck 2.
EXT TABLE OVERFLOW	2	Overflow of the external symbol table: the # must not exceed 255.	Irrecoverable error; press the space bar to return control to the EXEC.
FORTRAN SYS- SYSTEM TAPE?	1	The Compiler detects clear leader, indicating that you have the wrong tape, or that you've inadvertently rewound the system tape.	Type: <u>Y</u> to continue execution of the compiler. <u>N</u> to return control to the EXEC.
ILLEGAL OP- CODE	2	Compiler encountered an illegal ASSEMBLY language instruction.	Irrecoverable error. Press the space bar to return control to the EXEC.
ILLEGAL RE- CORD RESTART?	2	The Compiler read an illegal record while reading the intermediate tape.	Type: <u>Y</u> to restart Pass I. <u>N</u> to return program control to the EXEC.
MEMORY OVERFLOW	1 and 2	The source program is too large.	Irrecoverable error. Press the space bar to return control to the EXEC.
POS. NEXT FILE	1	The Compiler encountered an end-of-file before an END\$. In other words, the source is on more than one file.	Position the tape in Deck 2 to the beginning of the next source file, and press the space bar.
RESTART?	1 and 2	The Compiler execution has been terminated.	Type: <u>Y</u> to restart the Compiler with Pass I. <u>N</u> to return control to the EXEC.
REWIND ERR	1 and 2	The Cassette Unit cannot detect clear leader after a rewind.	Manually rewind the tape: press the space bar to continue.
SOURCE FILE #?	1	The Compiler is asking for the file number of the source program to be compiled.	Type the decimal file number.

Appendix C (Cassette SIO Driver Error Messages) describes the other messages that may appear during execution of the Cassette FORTRAN Compiler.

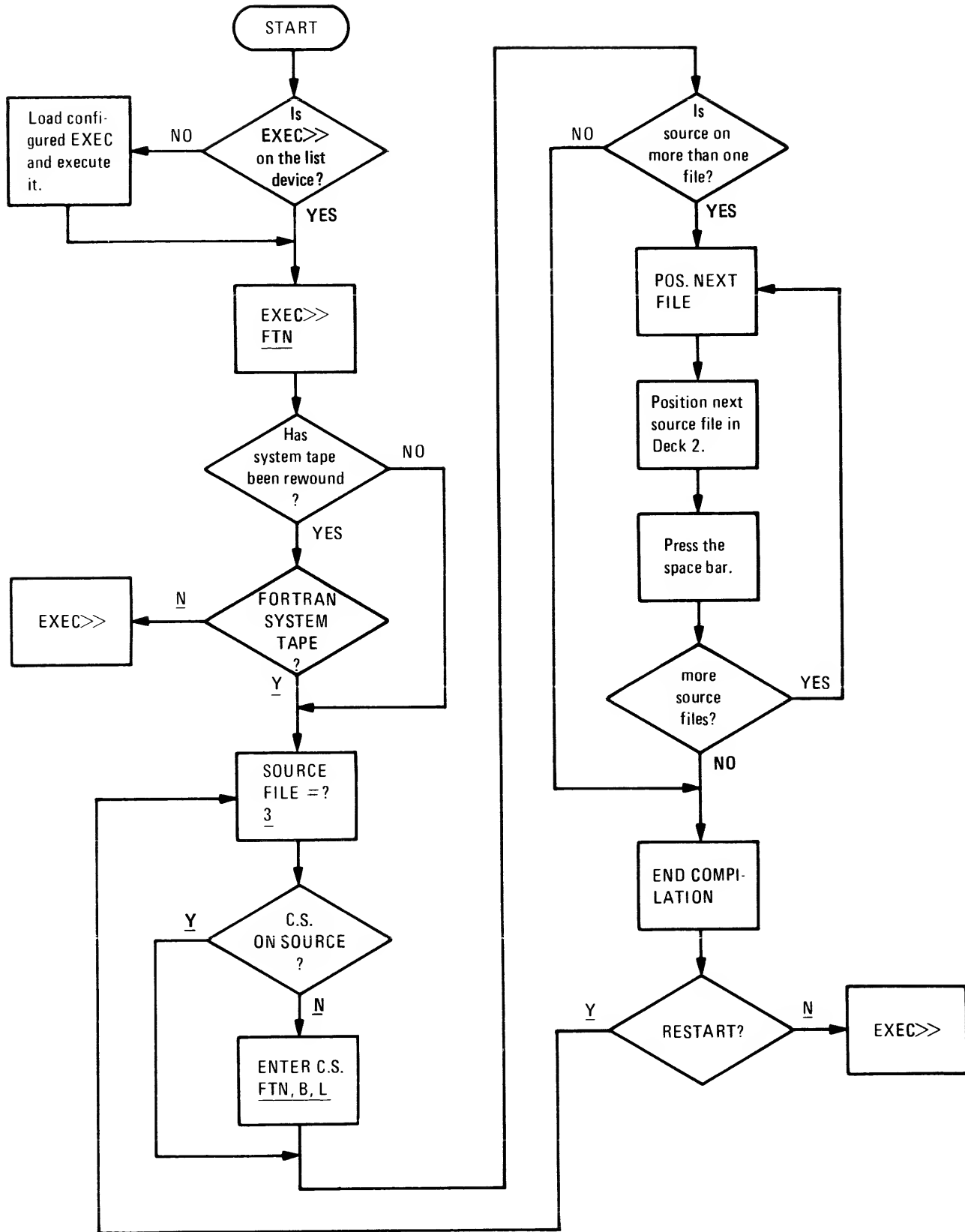


Figure 6-2. Cassette FORTRAN Compilation Procedures Flowgraph

```

      PROGRAM SMPSN
      DO 100 L=1,5
      READ (5,10) A,B,DELTX      — input is from Deck 2.
      WRITE(6,9) A,B,DELTX
9    FORMAT(/2F8.2,F7.2)
10   FORMAT (2E8.2,E7.2)
      TERML=cos(B)/B
      SUM=cos(A)/A
      K=(B-A)/DELTX
      C=4
      I=K+1
      DO 60 N=1,I
      FN=N
      IF (N-K)20,20,70
20   TERM=cos(A+FN*DELTX)/(A+FN*DELTX)
      IF (TERM-TERML) 30,70,30
30   SUM=SUM+C*TERM
      IF(C-4.)50,40,50
40   C=2.
      GO TO 60
50   C=4.
60   CONTINUE
70   SUM=SUM+TERML
80   SUM=(SUM*DELTX)/3
      WRITE(6,90) SUM
90   FORMAT("SUM=",E8.2)
100  CONTINUE
      STOP
      END
      END$

```

Figure 6-3. Example Source Program (Deck 1, File 1)

EXEC>>	
<u>FTN</u>	<i>FORTTRAN is called from the EXEC</i>
SOURCE FILE #?	<i>Program is on File 1 of Deck 2</i>
<u>1</u>	
C.S. ON SOURCE?	
<u>N</u>	<i>Control statement is to be entered now</i>
ENTER C.S.	
<u>FTN, B, L</u>	<i>Enter control statement</i>
FTN,B,L	
PROGRAM SMPSN	
DO 100 L=1,5	
READ (5,10) A,B,DELTX	
WRITE (6,9) A,B,DELTX	
9 FORMAT (/2F8.2,F7.2)	
10 FORMAT (2E8.2,E7.2)	
TERML=COS (B)/B	
SUM=COS(A)/A	
K=(B-A)/DELTX	
C=4.	
I=K+1	
DO 60 N=1, I	
FN=N	
IF (N-K) 20,20,70	
20 TERM=COS (A+FN*DELTX)/(A+FN*DELTX)	
IF (TERM-TERML) 30, 70, 30	
30 SUM=SUM+C*TERM	
IF(C-4.)50, 40, 50	
40 C=2.	
GO TO 60	
50 C=4.	
60 CONTINUE	
70 SUM=SUM+TERML	
80 SUM=(SUM*DELTX)/3.	
WRITE (6,90) SUM	
90 FORMAT ("SUM=",E8.2)	
100 CONTINUE	
STOP	
END	
END\$	
END COMPILATION	<i>Successful compilation</i>
RESTART?	
<u>N</u>	<i>Return control to the EXEC</i>
EXEC>>	

Figure 6-4. Compiler Operation Printout

1.23	4.72	.25
1.23	2.01	.10
0.34	1.01	.02
0.00	1.00	.01
1.00	1.25	.05

*Figure 6-5. Data on File 1 of Deck 2*

1.23	4.72	.25	
SUM=	-.63E+00		
1.23	2.01	.10	
SUM=	-.12E-01		
.34	1.01	.02	
SUM=	.88E+00		
.00	1.00	.01	
SUM=	.57E+36		
1.00	1.25	.05	
SUM=	.92E-01		
STOP			<i>From STOP routine</i>
RESTART?			
<u>N</u>			<i>Return control to the EXEC</i>
EXEC>>			

*Figure 6-6. Execution of the Object Program*

## SECTION VII

### CASSETTE BCS RELOCATING LOADER

#### GENERAL INFORMATION BCS Environments

For the following discussions, it's important to remember the distinction between the *host* system and the *target* system. The host system is the computer environment in which BCS operates. The target system is the computer environment in which the absolute program produced by BCS will operate.

#### Description

Cassette BCS provides the loading and input/output control capability for relocatable programs produced by the Cassette Assembler, the Cassette FORTRAN Compiler and the Cassette ALGOL Compiler.

There are two main parts of BCS:

- the BCS input/output drivers.
- the Cassette BCS Relocating Loader.

Cassette BCS performs these functions:

- a. Loads and links relocatable programs to produce an absolute object program that can be loaded by the Protected Binary Cassette Loader.
- b. Selects and loads library routines referenced by the relocatable programs.
- c. Processes I/O requests and services I/O interrupts.
- d. Configures I/O drivers assembled with the Microwave DEF format.

#### Standard vs. Cassette BCS

Cassette BCS provides the same capability as standard BCS plus other features. First of all, there is no PCS for Cassette BCS. Any Cassette BCS that contains the Reconfiguration routine (RCNFG) may be reconfigured by following the procedures described in RECONFIGURING CASSETTE BCS (in this section); note that this reconfiguration changes the I/O channel numbers, not the devices represented by those numbers. (To change the *devices* used within BCS, refer to CREATING A NEW CASSETTE BCS later in this section). Note, also, that this reconfiguration is temporary . . . the reconfiguration does not produce an absolute tape. (To obtain a new Cassette BCS absolute tape with the new configuration, see CREATING A NEW CASSETTE BCS.)

In Cassette BCS, the target and host machines may be different. The operator, during Cassette BCS execution, provides BCS I/O drivers and configuration information about the target system.

Cassette BCS provides better flexibility than standard BCS during the load stage of BCS execution. For example, during the load stage you may load programs from a cassette by typing in the name of the program. Cassette BCS also allows you to alter memory pointers during the loading stage; see the description of the MEM command in Table 7-1.

Another difference between the standard and the Cassette versions of BCS is the elimination of switch register options in the Cassette version. Switch register options available in the standard version have been replaced by keyboard inputs in the Cassette version: the exception is Switch 0 which is the bailout switch during the load stage of BCS execution.

Table 7-1. \*LOAD Responses

Response	Explanation
space key	Loads the program currently positioned on Deck 2.
END	Forces an end-of-loading.
LIB	Selectively loads routines from the Library on Deck 1 and outputs to the list device the name and bounds information for each routine loaded.
LIB/	Selectively loads routines from the Library on Deck 1 but suppresses the name and bounds output to the list device.
MEM	<p>Allows you to alter memory pointers. After Cassette BCS prints out the current value of a pointer, press the space bar to leave the value unchanged, or type the new octal value that you want to set in. Example responses are:</p> <p style="padding-left: 40px;">FWABP (NOW xxxxx) ? space  LWABP (NOW xxxxx) ?  FWAM (NOW xxxxx) ? 4000  LWAM (NOW xxxxx) ? space</p> <p>Note that the LWABP may not be changed.</p>
UND	List all undefined symbols in alphabetical order. If the Loader Symbol Table is large, the alphabetizing will produce a significant pause before the symbols are printed out.
other responses	<p>If you type any other name than those described above, the Relocating Loader will search Deck 2 for the program with that name. The name should have no more than five characters.</p> <p>If you call more than one program on Deck 2, call them in the sequence in which they appear on the tape. For example, if programs X and Y and Z are on the Deck 2 tape in that order, you may call in this order: X-Y-Z or X-Z or X, Y or Z alone, but <i>not</i> Z-X-Y or Y-X.</p> <p>You may bailout back the *LOAD command by setting switch 0 of the computer's switch register to ON (up for 2116 computers). Be sure to return the switch to the OFF (down) position before going on.</p>

**OPERATION**

There are three stages of Cassette BCS execution:

- configuration
- loading
- ending

**Configuration**

In the first stage of its operation, Cassette BCS inputs the configuration information that it will need to build tables and memory pointers that will be used by the target system.

The input comes either from the Standard Configuration file on the system tape in Deck 1, or from the operator via the keyboard (refer to OPERATING PROCEDURES in this section).

After inputting the standard configuration information, Cassette BCS loads the BCS I/O drivers from the system tape in Deck 1 and outputs them in absolute format onto the cassette in Deck 3. Cassette BCS stops inputting BCS I/O drivers when it encounters the STOP routine.

**Loading**

The second stage of Cassette BCS operation is loading relocatable programs, either as individual programs or as a library. In this stage, you may change memory pointers (by using the MEM command) or ask for a listing of undefined symbols (by using the UND command). (Table 7-2 defines the MEM and UND commands.) After you've loaded all the relocatable programs that you want to load, you can go to the third stage of cassette BCS operation by typing the END command.

**Ending**

In the final stage of operation, Cassette BCS outputs absolute links to the absolute file on the Deck 3 cassette, alphabetizes the Loader Symbol Table and outputs it to the Deck 3 cassette. You may then output the Loader Symbol Table to the list device. After listing the table, Cassette BCS returns control to the EXEC.

**References**

For a general description of BCS and PCS-like configuration questions, refer to the Basic Control System Manual. (02116-9017).

**PROGRAMMING  
INFORMATION  
I/O Configuration  
at Load Time**

At load time, cassette BCS can configure I/O drivers that have the Microwave DEF format. The program assigns a logical unit number (1-77 octal) to each device that has a separate I/O address, and then sets up an I/O configuration table at the front of each callable driver subroutine.

The first instruction in the table must be a DEF to the first usable code; this DEF must be *program* relocatable, not base page relocatable. Each I/O instruction to be configured must be DEF'd after the initial DEF. Only DEF's to I/O instructions may go in this section between the DEF to the first usable code, and the instruction containing the first usable code itself. For example, see Figure 7-1.

During execution, the I/O instructions specified by the I/O definition block are configured with I/O channel numbers provided by the INST CHNL ASSGN section of the Standard Configuration file. (See CREATING A NEW STANDARD CONFIGURATION FILE for a description of the entries in the INST CHNL ASSGN section).

At loading time, Cassette BCS determines if a given program is to be configured by checking the first instruction of the program. If the instruction is a DEF statement, the program will be configured. The I/O definition block will not appear in the absolute version of the program since program execution does not require the block.

If the first instruction of the program is not a DEF statement, Cassette BCS loads the program as a standard relocatable program.

*Figure 7-1. Example Program Using DEF Format*

*Table 7-2. Error Messages for Object Programs Produced by Cassette BCS*

## OPERATING PROCEDURES

- Deck 1 — a system tape with Cassette BCS on it; see the SYSTEM TAPE ORGANIZATION discussion above for the position of Cassette BCS on the system tape.
- Deck 2 — the relocatable tapes to be loaded.
- Deck 3 — the tape onto which the absolute file will be output.

Cassette BCS's first task is creating tables and memory pointers that will be used during loading. Cassette BCS needs configuration information to build those tables and pointers. Cassette BCS asks the following question to determine the source of the configuration information:

STNDRD CONFIG?

Y

Answer with Y, L or N:

- Y — if the configuration information will come from the Standard Configuration file on the tape in Deck 1. There will be no listing of the information.
- L — if the configuration information will come from the Standard Configuration file on the tape in Deck 1. Cassette BCS will list the configuration information.
- N — if you will enter the configuration information from the keyboard.\*

Whether you answer Y or L, Cassette BCS inputs the configuration information from the system tape in Deck 1.

After processing the configuration information, Cassette BCS loads the BCS drivers from Deck 1 and then checks to make sure that all drivers named in the EQT table have been loaded. If they have, Cassette BCS is ready to begin loading your relocatable programs, responding with:

\*LOAD  
DVM1      an example response

Respond with one of the commands described in Table 7-1.

When all of the programs have been loaded, type the END command to go to the final stage of Cassette BCS execution. This stage checks to see if any undefined symbols remain. If there are,

UNDEFINED EXT

warns you of the fact, but execution continues. The alphabetized Loader Symbol Table has already been output to the second file on Deck 3, but the following gives you the option of listing the table on the list output device:

\*LST  
Y

Answer with

- Y — to output the Loader Symbol Table to the list output device.
- N — to suppress the listing.

After successful completion of Cassette BCS, the list device prints out

\*END

Control then automatically passes to the EXEC.

---

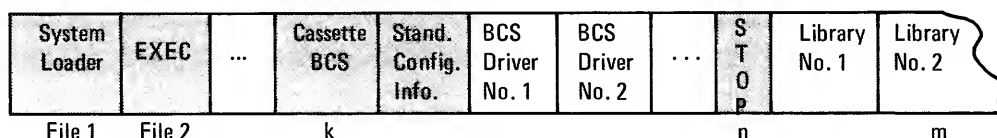
\*If you answer N, refer to the discussion of CREATING A NEW STANDARD CONFIGURATION FILE later in this section.

**SYSTEM TAPE ORGANIZATION**

The organization of the Cassette BCS system tape is vital to the execution of Cassette BCS. The structure and content of the system tape is illustrated in Figure 7-2. Some of the files are required: others are optional.

Assuming the absolute Cassette BCS is in file k, the other files should be organized as shown below:

- k + 1            standard configuration file; this file is required whether you input the standard configuration information from the system tape or from the keyboard.
- k + 2 thru n    all BCS drivers, terminated by the STOP routine; you have the option of putting the BCS drivers in, but you *must* put in the STOP routine.
- n + 1 thru m    all libraries needed; this is optional.



Shaded files are required.

*Figure 7-2. Cassette BCS System Tape Organization*

**CREATING A NEW STANDARD CONFIGURATION FILE****Description**

The Standard Configuration file contains information that BCS needs to configure programs so that they can run in the target system. The file contains responses to the questions described below.

The Standard Configuration information is usually a file on the system tape from which BCS can read it; however, if you answer the BCS STANDARD CONFIGURATION? question with N, you may enter the standard configuration information from the keyboard.

The standard Configuration file has six sections:

1. Memory pointers.
2. Equipment table entries (EQT).
3. Standard Equipment Table entries (SQT).
4. DMA information.
5. Interrupt linkages.
6. Instrument channel assignments.

**Memory Pointers.** Three memory pointers define where the programs being loaded will reside in core. The Cassette BCS memory pointer questions and example answers are shown below.

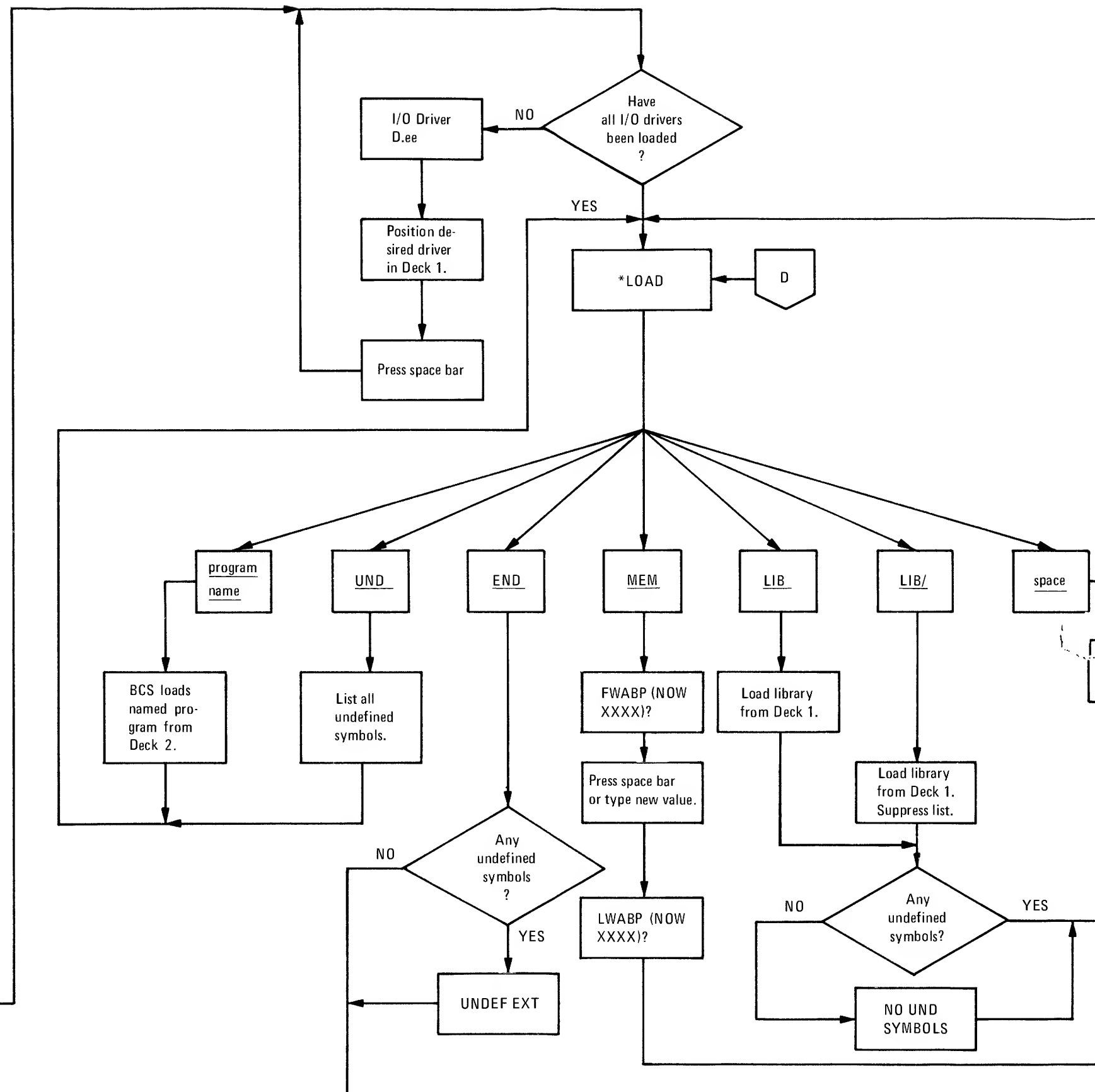
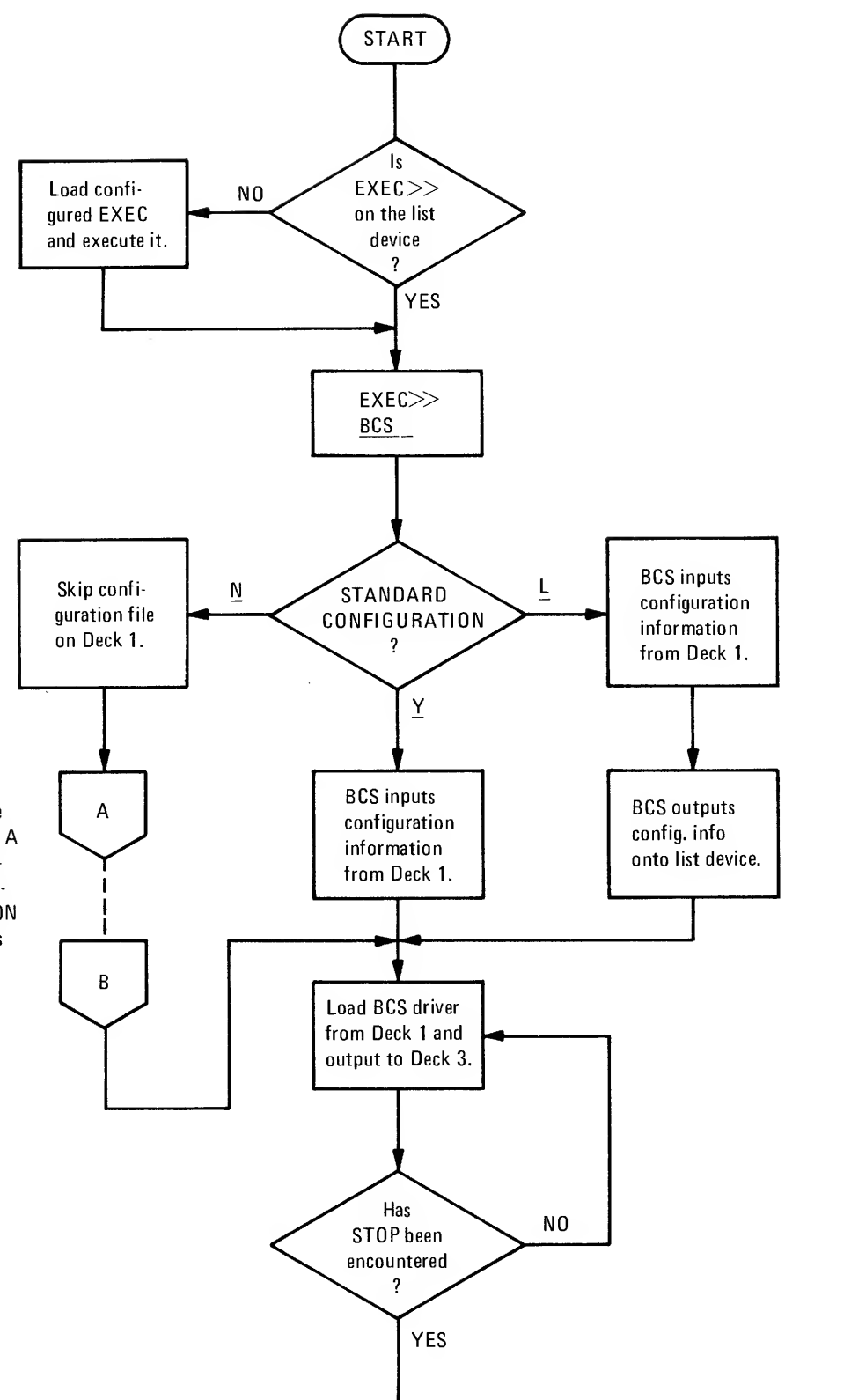
FWA BASE PAGE?  
100

The first word of available memory on the base page (FWA) should be less than 1000 octal, but greater than the last base-page word used for interrupt linkages.

LWA MEM?  
17477

If the target system is to be compatible with the Cassette Operating System, you must leave room in high core for the System Loader. To do this, answer the LWA

Refer to the  
CREATING A  
NEW STAND-  
DARD CON-  
FIGURATION  
FILE in this  
section.



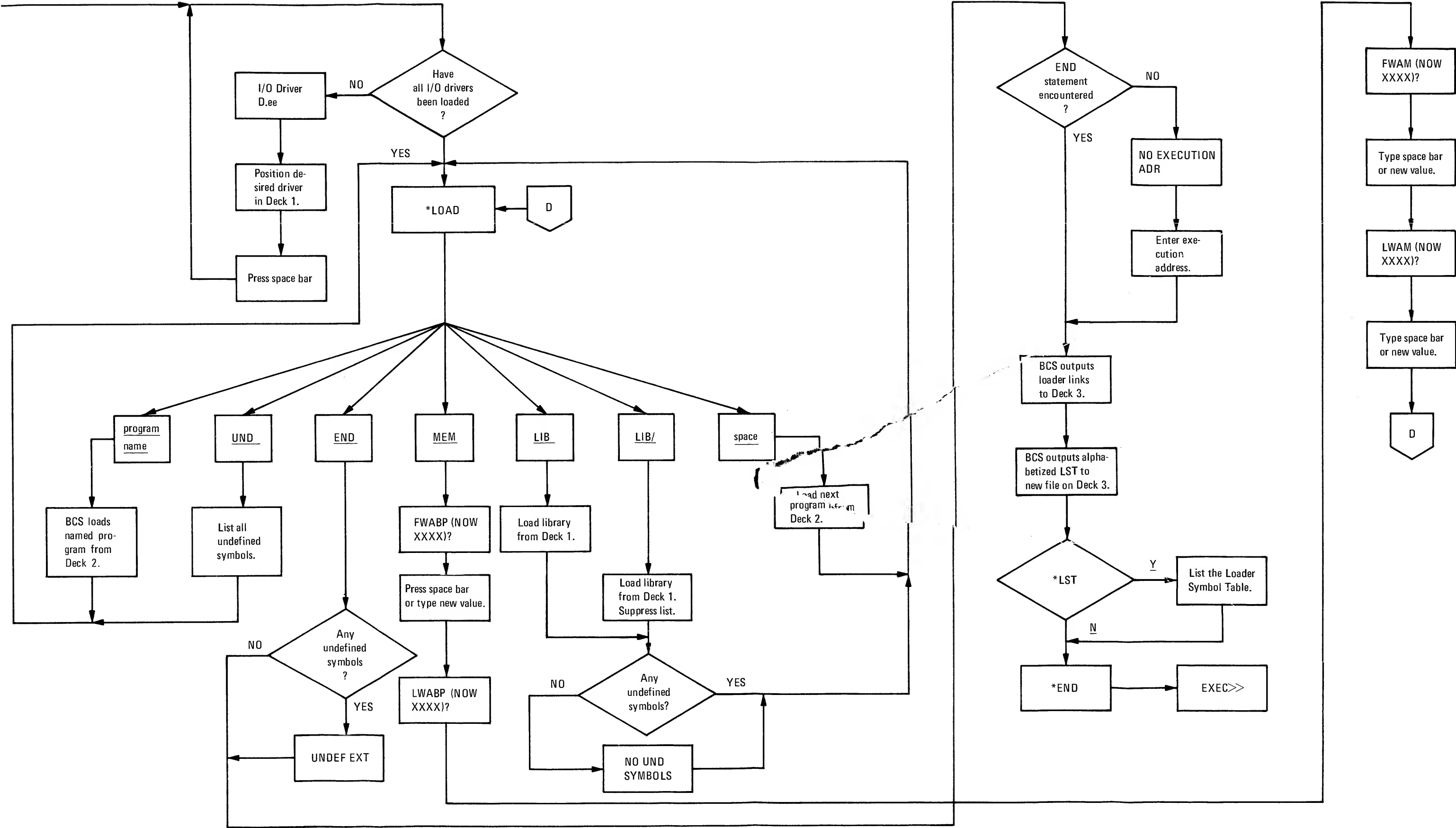


Figure 7-3. Cassette BCS Operating Procedures Flowgraph

EXEC>>

BCS

*BCS is loaded by the EXEC*

STNDRD CONFIG?

L

*Configuration on cassette; list information*

FWA BASE PAGE?

17

*Must be after interrupt linkages*

LWA MEM?

37477

*Must reside below System loader (X7500)*

LWA BASE PAGE?

1777

*Links are generated down from this base page address*

\* TABLE ENTRY

EQT?	<u>Unit Reference No.</u>	<u>Device</u>
10,D.35,U1	7	Deck 1
10,D.35,U2	10	Deck 2
10,D.35,U3	11	Deck 3
11,D.55	12	Buss control
12,D.61	13	Keyboard
12,D.62	14	List
/E		

SQT?

-KYBD?

13

-LIST?

14

-LIB?

7

-OUTPUT?

11

-INPUT?

10

-HDCPY?

14

DMA?

0

INTERRUPT LINKAGE?

10,15,I.35

11,16,I.55

/E

INST CHNL ASSGN?

10,11

11,12

/E

Base Page  
Interrupt Links

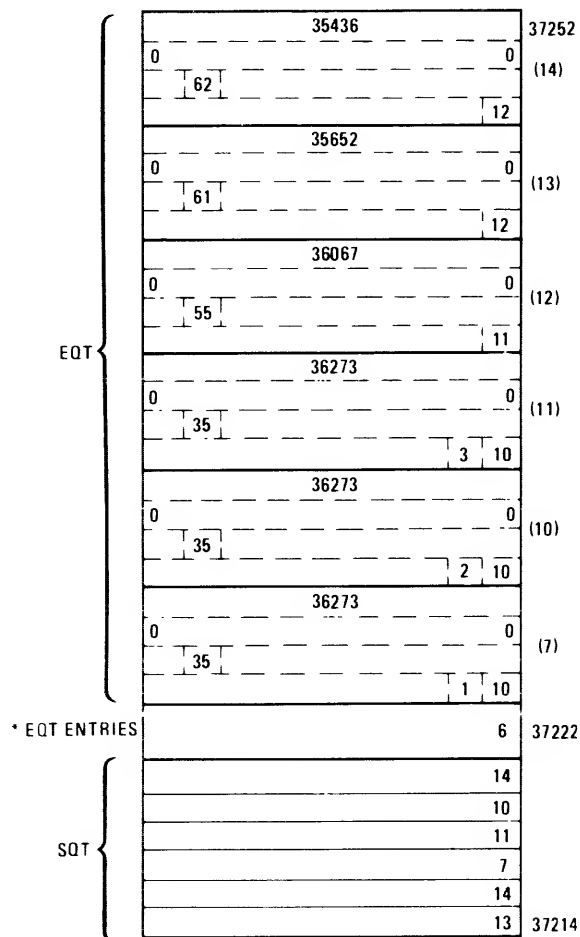
	:
16	36174
15	36725
	:
11	JSB 16, I
10	JSB 15, I
	:

Instrument Driver  
Channel Assignments

0	:
	:
20	15
21	16
	:
	:

Figure 7-4. Cassette BCS Example Printout

IOC	37253	37477	<i>EQT &amp; SQT</i>
			<i>occupy</i>
			<i>37214-37252</i>
D.35	36273	37213	
D.55	36067	36272	
D.61	35652	36066	
D.62	35436	35651	
BEQT	35431	35435	
PANEL	35402	35430	
STOP	35370	35401	



\*LOAD  
MEM

FWABP	(NOW 00017)?	"Space"	"Space leaves values unaltered"
LWABP	(NOW 01732)		
FWAM	(NOW 02000)?	4000	Change FWAM so programs start loading at 4000 <sub>8</sub>
LWAM	(NOW 35367)?	"Space"	

\*LOAD  
"Space"

CPLXT 04000 05615

\*LOAD  
"Space"

"Space" loads next program from Deck 2

CPLX4 05616 06367

\*LOAD  
SAVE3

Request to search for program named SAVE3

SAVE3 06370 06761

\*LOAD  
"Space"

PSFT1 06762 07033

Figure 7-4. Cassette BCS Example Printout (cont'd)

\*LOAD  
LIB

*Load and list special 8500A library*

.STOP 07034 07117

ERROR 07120 07361

\*LOAD  
LIB/

*Load from library; suppress list*

NO UND SYMBL

*No undefined symbols remain*

\*LOAD  
END

*Request "end stage" of BCS*

. . . sorting . .

*The Loader Symbol Table is being alphabetized*

\*LST  
Y

*List Loader Symbol Table*

NAME	ADDR	LINK	NAME	ADDR	LINK	NAME	ADDR	LINK
. . DLC	12326	01616	. . FCM	12320	01617	. BIO.	11435	00000
. BUFR	37424	00000	. CHEB	12235	01623	. DIO.	11356	01731
. DIV	13163	01615	. DLD	13253	01725	. DST	13266	01726
. DTA.	11466	01730	. ENTR	13004	01700	. ERRR	13362	01661
. FAD	12337	01711	. FDV	12474	01722	. FLUN	13475	01626
. FMP	12573	01721	. FSB	12342	01724	. GOTO	13454	01716
. IAR.	11312	00000	. IENT	12652	01620	. IOC.	37253	01655
. IOI.	11236	01717	. IOR.	11206	01727	. MEM.	35375	00000
. MPY	13044	01627	. PACK	12707	01660	. PWR2	13434	01621
. RAR.	11266	00000	. SQT.	37214	00000	. STOP	07034	01722
ABS	12313	01723	ADRES	00515	01613	AMBIT	36173	00000
ARCTA	11773	00000	ATAN	11773	01663	BEQT1	35432	01775
BEQT2	35435	01774	CADD1	06027	01707	CADD3	06036	01710
CDIV1	06200	01701	CDIV3	06207	01702	CLRIO	13515	01732
CMFY1	06115	01703	CMFY3	06124	01704	COS	12227	01657
CPAK1	05766	01713	CPAK3	05736	01715	CPLXT	04015	00000
CPOL1	06243	01712	CPOL3	06254	00000	CSUB1	06062	01705
CSUB3	06071	01706	CUPK1	06011	00000	CUPK3	05752	01714
D. 35	36273	00000	D. 55	36067	00000	D. 61	35652	00000
D. 62	35436	00000	DMAC1	37474	00000	DMAC2	37475	00000
ECHO	35623	01742	ENDIO	13506	01654	ERRCD	07264	00000
ERROR	07120	01773	EXEC.	35374	00000	FLOAT	12702	01625
FTOP3	06373	01675	GETAD	13314	01614	HALT	35370	01777
I. 35	36725	00000	I. 55	36174	00000	IFIX	13330	01720
ILFLG	07265	00000	IOERR	37453	00000	OLDIO	07570	00000
PANEL	35402	01733	PSFT1	06766	00000	PTOF3	06652	01677
SELD1	36123	01753	SELD2	36141	01750	SETUP	35422	01776
SIN	12152	01656	SQRT	12055	01665	XEQT	37473	00000
XSQT	37472	00000						

\*LINKS  
01613 01777

*Base page links used*

\*END  
EXEC>>  
LOAD 1 ON 3

*Successful termination  
Control is returned to the EXEC  
Load & execute absolute program produced*

Figure 7-4. Cassette BCS Example Printout (cont'd)

MEM question with 0X7477, where X is 1 for 8K, 2 for 12K, 3 for 16K, etc. You may leave room for other core resident modules in more complicated target systems by making LWAM appropriately smaller. However, for COS compatibility, LWAM must be no smaller than 0X0000 where the System Loader starts at 0X7500, with X as above.

LWA BASE PAGE?  
1777

The last word of available memory on the base page should be less than 2000 octal. Cassette BCS loads the links it generates *down* from the LWA BASE PAGE. A typical LWA BASE PAGE is 1777 octal.

**Equipment Table Entries.** Each I/O device must have an entry in the Equipment Table. An example Equipment Table question and answer is shown below.

\*TABLE ENTRY

EQT?  
10,D,35,U1  
10,D,35,U2  
10,D,35,U3  
11,D,00  
/E

The format for each entry is described below:

nn, D.ee [,D] [,Uu] [ ] = optional.

- nn The channel number (select code) of the device. For a device connected to two or more channels, nn is the lower number.
- D.ee The BCS symbolic name for the initiator section of the related equipment driver.
- D The Direct Memory Access channel required to operate the device (if any).
- Uu The physical unit number u (0-7) for addressing the device if the device is attached to a multi-unit controller.

Terminate the Equipment Table entries with /E as shown in the example above.

**Standard Equipment Table Entries.** Standard Equipment Table entries (SQT) couple the standard unit reference numbers (1 — 6) to devices described in the EQT.

Example Standard Equipment Table questions and answers are shown below.

SQT?	
<u>-KYBD?</u>	keyboard input device?
<u>12</u>	
<u>-LIST?</u>	list/comment output device?
<u>12</u>	
<u>-LIB?</u>	device for input of program library?
<u>7</u>	
<u>OUTPUT?</u>	standard output device?
<u>11</u>	
<u>-INPUT?</u>	standard input device?
<u>10</u>	
<u>-HDCPY?</u>	hardcopy output device?
<u>12</u>	

**DMA Information.** The answer to the DMA question tells BCS the availability of Direct Memory Access channels which Input/Output Control and equipment driver subroutines will control. An example question and answer are shown below.

DMA?  
6

The format of the DMA? answer is defined below:

$C_1, C_2$  ( $C_2$  is optional)

- $C_1$  should be 0 if no channel is available.  
should be 6 if one channel is available.
- $C_2$  should be 7 if the second channel is available.

**Interrupt Linkage Entries.** There should be an interrupt linkage entry for each input/output device.

An entry may be in either of two formats:

$a_1, a_2, I.ee$

- $a_1$  — the address of the interrupt location for the device
- $a_2$  — the base page address of the word that will contain the absolute address of the Interrupt Processor entry point.
- $I.ee$  — the entry point name of the Interrupt Processor section of the equipment driver.

$a, c$

- $a$  — the address of the interrupt location for the device.
- $c$  — the octal constant that will be stored in location “a”.

You must terminate entries with /E as shown in the example below:

```

INTERRUPT LINKAGE?
10, 12, I.35
11, 13, I.00
15, 102044
/E
    
```

**Instrument Channel Assignments.** Instrument channel assignment entries give Cassette BCS the information it needs to configure drivers assembled with the Microwave DEF format.

Instrument channel assignment entries must have the following format:

$n, a$

- $n$  is the logical unit number of the device used in the program.
- $a$  is the actual I/O channel number of the device.

Terminate instrument channel assignment entries with /E as shown in the example below:

```

INST CHNL ASSGN?
5, 15
2, 10
/E
    
```

**Writing the New File** To create a new Standard Configuration file, use the EXEC to write your responses to the above questions (in the order in which they appear above) on the system tape. Refer to Table 2-1 for a description of the WRITE command. Be sure to write an end-of-file.

For example, the Standard Configuration file made up of all the above answers would be as shown below:

```

100
17477
1777
10, D.35, U1
10, D.35, U2
10, D.35, U3
11, D.00
/E
12
12
7
11
10
12
6
10, 12, 1.35
11, 13, 1.00
15, 102044
/E
5,15
2,10
/E

```

## CREATING A NEW CASSETTE BCS

### General

The Cassette BCS Relocating Loader is a relocatable program; configured with IOC and appropriate BCS drivers, the Relocating Loader becomes Cassette BCS, an absolute program. The Loader uses IOC to perform all input/output operations; BCS refers to standard units; BCS . . .

- inputs your responses through unit 1, the Keyboard.
- outputs comments to you on unit 2, the list output device.
- reads the configuration file, BCS I/O drivers (including IOC and STOP) and all libraries from unit 3, the Program Library unit.
- outputs the absolute program produced by BCS to the standard output unit, unit 4.
- reads the relocatable object programs from unit 5, the standard output unit.
- outputs program names and memory bounds, as well as the Loader Symbol Table listing on the hard-copy device (unit 6).

### Preparation

To create a new Cassette BCS, you'll need the following software modules:

- a standard configuration file for the target system (refer to CREATING A NEW STANDARD CONFIGURATION FILE in this section).
- BCS I/O drivers (and libraries, if necessary) for the target system; the drivers must include IOC and STOP).
- the relocatable program, the Cassette BCS Relocating Loader.

Next, prepare a cassette as follows: call it Target System Configuration Information (TSCI):

File 1 — should contain the standard configuration information for the target system.

File 2

and later files — should contain BCS I/O drivers (and libraries, if needed) for the target system; the drivers must include IOC and STOP.

What you have prepared is a BCS “system tape” without the first three files (SYSLD, EXEC, BCS).

**Operating Procedures** To create a new Cassette BCS, follow the procedures below:

- a. Load the Cassette BCS configured for the *host* system: BCS will output STNDRD CONFIG?
- b. Remove the host-system Cassette BCS system tape from Deck 1.
- c. Insert in
  - Deck 1, the TSCI cassette.
  - Deck 2, the Cassette BCS Relocating Loader cassette.
  - Deck 3, the cassette on which the new absolute Cassette BCS for the target system is to be output.
- d. Respond with Y (or L) to the STNDRD CONFIG? question.
- e. Respond to the first \*LOAD command by pressing the space bar.
- f. If any libraries are to be loaded, respond with LIB to the \*LOAD question.
- g. Respond with END to the final \*LOAD command.
- h. Respond with Y.
- f. As the Loader Symbol Table is being output, remove the TSCI cassette from Deck 1 and insert the original host-system Cassette BCS system tape.

After host Cassette BCS execution has ended, create a new system tape for the target system, using the new absolute Cassette BCS (now in Deck 3).

For example, assume that you now have a cassette/teleprinter system, but you are changing the teleprinter to an 8500A System Console. So the teleprinter system is the host system, and the 8500A system is the target system. Figure 7-5 shows the system tape for the *target* system.

Figure 7-6 shows an example of the host Cassette BCS execution sequence.

## RECONFIGURING CASSETTE BCS

### Description

The absolute Cassette BCS supplied with the cassette operating system contains the Reconfiguration routine (RCNFG). RCNFG allows you to reconfigure the I/O channels of the devices used by Cassette BCS; (to change the *devices*, refer to CREATING A NEW CASSETTE BCS earlier in this section).

This reconfiguration is temporary; this procedure does not produce an absolute tape. Refer to CREATING A NEW CASSETTE BCS to produce a new absolute tape for Cassette BCS with a new configuration.

In the reconfiguration procedure you’ll supply information which RCNFG uses to change the first word of each Equipment Table Entry referenced as a Standard Unit. RCNFG also modifies the base page interrupt locations, and repositions the links to the continuator routines to locations 72-77 octal.

There are three restrictions on the use of RCNFG with the Cassette BCS Loader:

- a. No links may reside in locations 72-77 octal: these locations are reserved for the continuator addresses of the devices referenced by the SQT.
- b. Only I/O links may reside in the interrupt locations; *no* constants are allowed there.
- c. The first word of available base page (FWA BASE PAGE) must be 100 octal.

File 1     System Loader

File 2     EXEC.

File k:    Cassette BCS (configured for the host system).

File k + 1: Standard configuration information for the target system  
(the file contains responses only):

FWA   BASE   PAGE?	SQT?
17	—KYBD?
LWA   MEM?	13
37477	—LIST?
LWA   BASE   PAGE?	14
1777	—LIB?
	7
*   TABLE ENTRY	—OUTPUT?
	11
EQT?	—INPUT?
10,D.35,U1	10
10,D.35,U2	—HDCPY?
10,D.35,U3	14
11,D.55	
12,D.61	DMA?
12,D.62	0
/E	
	INTERRUPT LINKAGE?
	10, 15, I.35
	11, 16, I.55
	/E
	INST   CHNL   ASSGN?
	10,11
	11,12
	/E

File k + 2:    IOC,   Input/Output Control routine.

File k + 3:    D.35,   the Cassette BCS driver.

File k + 4:    D.55,   Buss BCS driver.

File k + 5:    D.61,   Keyboard BCS driver.

File k + 6:    D.62,   Printer BCS driver.

File k + 7:    BEQT, Buss Equipment Table.

File k + 8:    PANEL,   Control Panel BCS driver.

File k + 9:    STOP, STOP routine.

File k + 10:   Special 8500A Library

BCS I/O Drivers  
for the 8500A  
System Console  
(the target system).

Figure 7-5. Example System Tape for Creating a New BCS

STNDRD CONFIG?

Y*TSCI is in Deck 1*

\*LOAD

"space"*Relocating Loader is in Deck 2*

LOADR 02000 12731

\*LOAD

LIB

.STOP 12732 13015

ERROR 13016 13257

*Library routines needed*

\*LOAD

LIB*for 8500A BCS Drivers*

ENDIO 13260 13266

NO UND SYMBL

\*LOAD

END

\*LST

Y

NAME	ADDR	LINK	NAME	ADDR	LINK	NAME	ADDR	LINK
.BUFR	37424	00000	.IOC.	37253	01731	.MEM.	35374	01542
.SQT.	37214	00000	.STOP	12732	01772	AMBIT	36172	00000
BEQT1	35431	01775	BEQT2	35434	01774	D.35	36272	00000
D.55	36066	00000	D.61	35651	00000	D.62	35435	00000
DMAC1	37474	00000	DMAC2	37475	00000	ECHO	35622	01742
ENDIO	13260	01457	ERRCD	13162	00000	ERROR	13016	01773
EXEC.	35373	00000	HALT	35367	01777	I.35	36725	00000
I.55	36173	00000	ILFIG	13163	00000	IOERR	37453	00000
PANEL	35401	01733	SELD1	36122	01753	SELD2	36140	01750
SETUP	35421	01776	XEQT	37473	00000	XSQT	37472	00000

\*LINKS

01457 01777

\*END

Figure 7-6. Making a New Cassette BCS Printout

**Operating Procedures** Use the following procedure to reconfigure Cassette BCS.

- a. Load the Cassette BCS using the Protected Binary Cassette Loader (see Appendix A for the procedure).
- b. Set the P Register to 100 octal.
- c. Set the octal I/O channel numbers for the keyboard and list device into the switch register as follows:

Bits 14—9      Keyboard channel: Standard Unit No. 1.  
 Bits 5—0      List channel: Standard Unit No. 2.

- d. Press PRESET, RUN.
- e. Answer the following questions when they are output on the list device:

Message	Channel	Standard Unit No.
LIB CHNL?	Library input	3
OUT CHNL?	Standard output	4
INP CHNL?	Standard input	5
HDCPY CHNL?	Hardcopy output	6

Answer each question with the appropriate two-digit octal number representing the I/O channel. If you don't want to change an I/O channel, type the space bar.

An invalid answer produces an \*ERROR message on the list device. See Table 7-3 for a description of \*ERROR.

*Table 7-3. \*ERROR Message for Reconfiguring Cassette BCS.*

Message	Meaning	Action
*ERROR	You answered with more or less than two octal digits, or you answered with non-numeric characters. The CHNL? question is repeated.	Answer with the valid characters.

### CAUTION

If you try to run Cassette BCS before you've reconfigured it, or if you haven't entered the correct I/O channel numbers into the switch register for the keyboard and list devices, you'll have to reload the absolute Cassette BCS (containing the Reconfiguration Routine) before you can restart. Use the Protected Binary Cassette Loader to load it.

- f. Program control automatically passes to the newly configured Cassette BCS.

Example. Assume you've received an absolute Cassette BCS configured as follows:

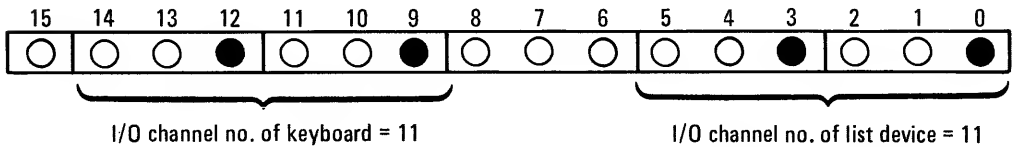
I/O Channel	Device
10	Cassette Unit
15	Teleprinter

But the actual configuration of your system is:

I/O Channel	Device
10	Cassette Unit
11	Teleprinter

The devices are the same: only the I/O channels differ. So, you can use RCNFG to temporarily reconfigure your Cassette BCS. Load the absolute Cassette BCS (using the Protected Binary Cassette Loader), set the P-Register to 100 octal.

- a. Set the switch register as shown



- b. Press PRESET and then press RUN.
- c. Answer the I/O channel number questions:

LIB CHNL?	}	pressing space bar after each question leaves the Cassette Unit in I/O slot 10.
OUT CHNL?		
INP CHNL?		
HDCPY CHNL?		
<u>QQ</u>		an invalid entry.
*ERROR		
HDCPY CHNL?		
<u>11</u>		change hardcopy channel to 11. BCS execution begins: refer to Cassette BCS operating procedures earlier in this section.
STNDR CONFIG?		

MESSAGES

Messages output during execution of Cassette BCS fall into four categories. Table 7-4 describes the categories.

Table 7-4. Cassette BCS Messages

Type	Action
Information request.	Answer.
Information outputs.	None necessary.
Recoverable.	Correct the error; type the space bar to continue.
Irrecoverable.	Press the space bar to return to the EXEC.

Table 7-5. defines each of the messages that may appear during execution of Cassette BCS.

Table 7-5. Cassette BCS Messages

Message	Explanation	Operator Action
CASSETTE ERROR	There's an error in the Cassette Unit.	Irrecoverable error: run cassette diagnostics.
CHECKSUM ERROR	The checksum read on the last record does not agree with the checksum calculated by the Loader.	Irrecoverable error: reexecute Cassette BCS or reassemble or compile the program.
*COMMON	Outputs the common area bounds.	None.
COMMON ERROR	The COMMON block in the current program is longer than the first COMMON block allocated.	Irrecoverable error. Rerun Cassette BCS, loading largest COMMON first, or reassemble or recompile the program.
DECK NOT READY	Deck currently referenced is not available. Either there is no cassette in the deck, or you haven't depressed the loading bar, or the unit is OFF-LINE.	Ready the deck; press the space bar.
DMA?	Asks for information about DMA channels.	See CREATING A NEW STANDARD CONFIGURATION FILE earlier in this section.
DUPLICATE ENTRY LLLLL	An entry point (LLLLL) in the current program matches a previously declared entry point.	None; Cassette BCS ignores the entry point and continues execution.
*END	Cassette BCS has been successfully completed.	None. Control automatically passes to the EXEC.
END OF TAPE	During READ or WRITE, the Cassette Unit detected clear leader, implying an end-of-tape condition.	Irrecoverable error; you'll have to put the data on more than one cassette.
*EQR	The output device isn't ready.	Try again: press RUN.
*ERROR	You've entered a non-numeric or other character as a reply to a configuration question.	If you're inputting from the keyboard, re-input the correct value. If inputting from the cassette, press the space bar to return control to the EXEC . . . with which you can correct the tape.
FWA BASE PAGE?	Request for the initial first word of available base page.	See CREATING A NEW STANDARD CONFIGURATION FILE earlier in this section
FWABP (NOW XXXXX)	Request for new first word of available base page.	Press space bar to leave current value unchanged, or type in an octal number to change the current value.

Table 7-5. Cassette BCS Messages (cont'd)

Message	Explanation	Operator Action
FWAM (NOW XXXXX)?	Request for new first word of available memory during the load stage.	Press the space bar to leave current value unchanged, or type in an octal number to change the current value.
ILLEGAL RECORD	The last record is not one of the five types accepted by the Loader.	Irrecoverable error. Rerun Cassette BCS or re-assemble or re-compile the program.
INST CHNL ASSGN?	Asks for the instrument channel assignments that are necessary to configure drivers that use the DEF format.	Refer to CREATING A NEW STANDARD CONFIGURATION FILE earlier in this section.
INTERRUPT LINKAGE?	Asks for interrupt linkage information.	Refer to CREATING A NEW STANDARD CONFIGURATION FILE earlier in this section.
I/O ADDR BUF OVF	The buffer that holds I/O configuration addresses has overflowed.	Irrecoverable error. Reduce the no. of configurable drivers in a single execution of Cassette BCS.
I/O DRIVER? D.ee	A driver has been named in the EQT entry but has not been loaded.	Position the driver in Deck 1 and then press the space bar. Be sure to reposition the tape in Deck 1 to any libraries needed.
I/O DRV REQ DEF	An I/O driver now being configured has an instruction other than a DEF to an I/O instruction before the first usable code.	Irrecoverable error. Reassemble the driver; see the discussion of the DEF format.
LDR SYMBL TBL OV	Loader symbol table overflow; the number of EXT/ENT records exceeds available memory.	Irrecoverable. Reduce number of EXT/ENT records if possible, or increase computer core size.
LINKAGE OVER- FLOW	Linkage words supplied by the loader for references between pages exceed the available base page memory.	Irrecoverable error. Reduce number of linkage words or change the loading sequence during the BCS execution.
*LINKS	Lists the absolute bounds for base page links.	None.
*LOAD	Asks for a load command.	Refer to the OPERATING PROCEDURES discussion in Table 7-1.
*LST	Do you want to output the Loader Symbol Table on the list device?	Type Y — to list the L.S.T. N — to terminate BCS.

Table 7-5. Cassette BCS Messages (cont'd)

Message	Explanation	Operator Action
LWA BASE PAGE?	Asks for the initial last word of base page; the links will be loaded down from this word.	See CREATING A NEW STANDARD CONFIGURATION FILE.
LWABP (NOW XXXXX)	Outputs the current value of the last word of available base page memory	None.
LWA MEM?	Asks for initial last word of available memory.	See CREATING A NEW STANDARD CONFIGURATION FILE in this section.
LWAM (NOW XXXXX)?	Asks for a new last word of available memory during the load stage.	Type <ul style="list-style-type: none"> <li>— the space bar to leave the current value unchanged.</li> <li>— an octal number to replace the current value.</li> </ul>
MEMORY OVERFLOW	The length of the main or base page portion of the program, or the common block exceeds the bounds of available memory.	Irrecoverable error. Revise the program.
NAM RCD OUT SEQ	Name record out of sequence. A NAM record was encountered before the previous program was terminated with an END record.	Irrecoverable error. (Re-execute cassette BCS or re-assemble/compile program.)
NO DEF-BASE PAGE	The first DEF in a configurable I/O driver must not be on the base page.	Irrecoverable error. (Re-assemble program following instructions on DEF format).
NO EXECUTION ADR	The initial starting location (e.g., an END statement operand) is not present in any of the programs loaded.	Type the octal starting address.
NO UND SYMBL	No undefined symbols remain after a library load or when a list of undefined symbols is requested.	Type END as a response to the LOAD command to terminate Cassette BCS.
PROG LENGTH 0	A program of zero length has been encountered while loading BCS I/O drivers.	Irrecoverable error (re-assemble BCS I/O driver).
READ ERROR	Read error on the cassette unit.	Irrecoverable error. (Re-execute BCS or run cassette diagnostics.)
SORTING	The Loader Symbol Table is being alphabetized.	None.

Table 7-5. Cassette BCS Messages (cont'd)

Message	Explanation	Operator Action
SQT? – KYBD? – LIST? – LIB? – OUTPUT? – INPUT? – HDCPY?	Request for standard equipment Table entries.	See CREATING A NEW STANDARD CONFIGURATION FILE.
START OF TAPE	Leader/oxide was detected after rewind implying beginning of tape condition on the cassette.	Irrecoverable error.
STNDRD CONFIG?	Request for position of responses to configuration questions.	See Operating Procedure (standard configuration question).
TABLE ENTRY EQT?	Request for equipment table entries.	See CREATING A NEW STANDARD CONFIGURATION FILE.
UNDEF. EXT	And end-of-load has been requested and there are still undefined externals.	None. End-of-load continues with references to undefined symbols.
UNDEF EXT: LLLLL	A forward reference to an undefined external (LLLLL) has been encountered.	None. Only the opcode of the instruction is output to the absolute file. Execution continues.
UNDEFINED SYM- BOL LLLLL	An entry point (LLLLL) in either IOC or STOP cannot be located.	Irrecoverable error. (Re-execute Cassette BCS making sure IOC and STOP are on the system tape in Deck 1).
WRITE ERROR	Write error on the cassette unit.	Irrecoverable error. (Re-execute cassette BCS or run cassette diagnostics.)
WRITE LOCK-OUT	The cassette now in Deck 3 has the write-protect tab taken out, preventing the hardware from writing on the tape.	Insert a new cassette in Deck 3. Type "space."

## SECTION VIII

### CASSETTE SYMBOLIC EDITOR

#### GENERAL INFORMATION

##### Description

The Cassette Symbolic Editor is the SIO program that provides the user with symbolic editing capabilities in the cassette operating environment. Edit Files and/or source files to be edited are read from the cassette(s) in Deck 2, and the edited source file produced is written on the cassette in Deck 3.

##### References

The differences between the Cassette Symbolic Editor and the HP Symbolic Editor are minimal. Remembering that Deck 2 replaces the photoreader and Deck 3 replaces the punch, refer to the Symbolic Editor Manual (02116-9016) for a general description of the Editor and its operating procedures. Note the differences in Operating Procedures outlined below.

##### Break Option

At any time during execution of the Cassette Symbolic Editor the user may interrupt its operation by depressing the BREAK button. Control will be transferred to the RESTART? question, where the user has the option to either restart the Editor or return control to the EXEC.

This option does not apply to teleprinter systems.

#### OPERATING PROCEDURES

To prepare the cassette unit for an edit, insert in:

- |        |   |  |
|--------|---|--|
| Deck 1 | — | a system tape with the Cassette Symbolic Editor on it.   |
| Deck 2 | — | the source tape(s) to be edited, (or the Edit File followed by the source tape(s) to be edited). |
| Deck 3 | — | the tape on which the edited file is to be output.   |

Once the Cassette Symbolic Editor has been loaded by the EXEC, its operating procedures differ from those of the HP Symbolic Editor in the following ways:

1. Request for source file number.
2. Meaning of /P command.
3. Meaning of /E command.
4. Restart capability.

##### Source File Number Question

SOURCE FILE #?

2

This question refers to decimal file numbers of sources on the cassette in Deck 2. Valid responses are 1 — 9. Invalid responses are ignored and the question is asked again. If the Edit File is on cassette, respond with the file number of the Edit File.

The source files to be edited should be positioned immediately after the Edit File. Otherwise, off-line positioning of the source file to be edited will be necessary prior to a response to the SYMBOLIC FILE SOURCE DEVICE? question.

##### Meaning of the /P Command

If the Edit File is not on cassette, respond with the file number of the source program to be edited. In either case, Deck 2 will be rewound and positioned to the designated file.

1. In response to EDIT FILE DEVICE, /P specifies that the Edit File is to be read from the currently positioned file on the cassette in Deck 2.
2. In response to SYMBOLIC FILE SOURCE DEVICE?, /P specifies that the symbolic file input medium is the cassette in Deck 2.

Table 8-1. Responses to the Symbolic Editor

Message/ Response	EDIT FILE DEVICE?	SYMBOLIC FILE SOURCE DEVICE?	SYMBOLIC FILE DESTINA- TION DEVICE?	**END-OF-TAPE * (end-of-Edit File tape)	**END-OF-TAPE * (end of Symbolic File input).
/T	Edit file is to be typed on key- board.	—	—	—	—
/P	Edit file is to be read from Deck 2.	Symbolic file input medium is Deck 2.	Symbolic file output medium is Deck. 3	—	—
/M	—	Symbolic file input medium is mass storage .	Symbolic file output medium is mass storage.	—	—
/C	—	—	—	Edit file control en- try is to be made on the keyboard. The entry must be /E to terminate Edit File.	The next tape to be read is a continua- tion of the Symbolic File input tape just read.
/E	—	—	—	(After a /C). The last tape read was the end of the Edit File.	The tape just read was the end of the current Symbolic File input. /E writes an end-of-file on the output device.
GO	—	—	—		The last tape read was the end of the current Symbolic File input. The edit cycle begins.

3. In response to SYMBOLIC FILE DESTINATION DEVICE?, /P specifies that the symbolic file output medium is the cassette in Deck 3.

In response to \*END-OF-TAPE and an asterisk at the end of a symbolic file input tape, /E specifies that the last tape read was the end of the current symbolic file input.

/E writes an end-of-file on the Deck 3 cassette. The newly edited file must have an end-of-file before it can be used in the Cassette Operating System.

The following question is output after normal completion of the Cassette Symbolic Editor or (where applicable) from depression of the BREAK button. Respond with Y or N:

Y to restart execution of the Cassette Symbolic Editor.

N to return control to the EXEC.

The following messages are unique to the Cassette Symbolic Editor.

*Table 8-2. Cassette Symbolic Editor Messages*

Message	Explanation	Action
RESTART?	Execution of the Editor has been terminated.	Type Y to restart the Editor. N to return to the EXEC.
REWIND ERR	Hardware error; no leader detected after rewind.	Manually rewind the tape; press the space bar to continue.
SOURCE FILE #?	Asks for file number of source in Deck 2.	Type in the decimal file number.

Refer to the Cassette SIO Driver Error Messages in Appendix C for any other messages that appear during execution of the Cassette Symbolic Editor.

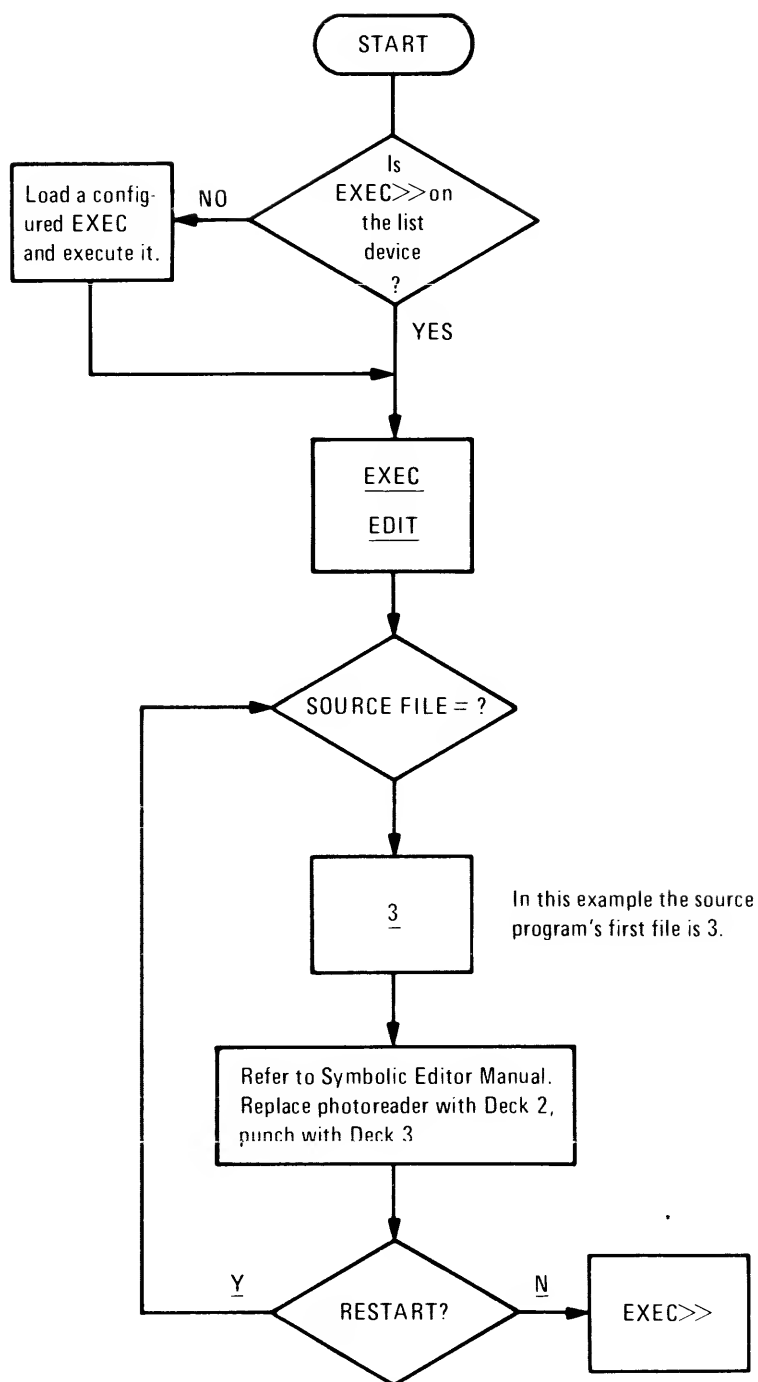


Figure 8-1. Cassette Symbolic Editor Operating Procedures Flowgraph

*Edit File: File #1 on Deck 2*

```
/CD,6 12  
/CD,13, 2  
/E
```

*Symbolic File Input #1: File #2 on Deck 2*

```
ASMB, B,L,A  
      ORG 115B  
      LDA PRNTS  
      STA COUNT  
COUNT BSS 1  
START  LDA LENGTH  
      LDB BUFF  
      JSB 102B, I  
      ISZ COUNT
```

*Symbolic File Input #2: File #3 on Deck 2*

```
      JMP START  
      HLT 15B  
BUFF  DEF MSG  
LENGTH OCT 14  
PRNTS DEC -10  
MSG   ASC 6, TEST OUTPUT  
END   COUNT
```

*Figure 8-2. Edit Example*

*Execution Control Messages*

```

EXEC>>
EDIT                               Editor is called from the EXEC
SOURCE FILE #?
1                                  Edit File is File #1

EDIT FILE DEVICE?
/P                               Refers to Deck 2

SYMBOLIC FILE SOURCE DEVICE?
/P                               Refers to Deck 2

SYMBOLIC FILE DESTINATION DEVICE?
/P                               Refers to Deck 3

DK 2 EOF
DK 2 EOF

**END-OF-TAPE
*
/C

DK 2 EOF

**END-OF-TAPE
*
/E                               Writes end-of-file on Deck 3

*END
RESTART?
N                               Control is returned to the EXEC

EXEC>>

```

*Symbolic File Output Deck 3*

```

ASMB, B, L, A
      ORG 115B
      LDA PRNTS
      STA COUNT
COUNT BSS 1
START  LDA LENGTH
      LDB BUFF
      JSB 102B, I
      ISZ COUNT
      JMP START
      HLT 15B
      BUFF DEF MSG
      LENGTH OCT 14
      PRNTS DEC -10
      MSG ASC 6, TEST OUTPUT
      END COUNT

```

*Figure 8-2. Edit Example (cont'd)*

## SECTION IX

### CASSETTE BASIC

#### GENERAL INFORMATION

Cassette BASIC is a version of ATS BASIC, described in ATS BASIC FOR AUTOMATIC TEST SYSTEMS.<sup>1</sup>

This chapter describes only those features of ATS BASIC which are unique to Cassette BASIC. We've assumed here that Cassette BASIC is operating with an 8500A System Console including a keyboard, printer, and control panel. Differences between this configuration and a teleprinter configuration will be noted. Note that Cassette BASIC is typically supplied with an automatic test system or with the 8500A Interactive Graphics Option, or both. If so, BASIC will include additional statements (CALLS) which apply to the particular system. The user should consult the appropriate manuals for a description of these extra statements.

#### Loading the Basic Interpreter

The BASIC Interpreter should be a system program on a system tape. In this case BASIC may be loaded from the EXEC by typing BASIC. The EXEC will then load and execute the BASIC Interpreter. The BASIC Interpreter can also be loaded with the Protected Binary Cassette Loader (Appendix A), in which case the starting address for BASIC is 2. BASIC will respond with READY and wait for you to enter program statements or system commands.

#### Editing

You may edit a line entered from the keyboard in one of two ways. The DEL CHAR key (reverse arrow (←) key on the teleprinter) deletes the character immediately preceding in the input line. Pressing the DEL LINE key (rubout key on the teleprinter) deletes the entire line being typed.

BASIC statements are preceded by a line number. As statements are entered they are stored in that portion of the computer memory reserved for the BASIC program, the *work-space file*. You may enter statements in any order; the Interpreter puts them in numerical order. A statement may be deleted from the work-space file by typing the statement number and pressing the carriage return key.

#### Cassette File Management

The Cassette BASIC Interpreter limits the programmer to use decks two and three, thus protecting the system tape in deck one. The Interpreter maintains a record of the file positions of the cassettes in decks two and three. For example, assume the cassette in deck three is currently positioned to the start of the third file; a request to position to file four will cause the unit to skip one file. To position to file two, the Interpreter rewinds the deck and then skips one file. As long as BASIC is not inputting or outputting to a deck you may manually rewind the deck. Before each operation on the cassette unit the interpreter checks to see if the cassette has been rewound. However, going OFF LINE and positioning a cassette is forbidden, since the Interpreter cannot keep track of the tapes in the OFF-LINE mode.

#### Break Capability

To stop running a BASIC program at any time, press the BREAK button on the System Console control panel. BASIC will print:

STOP  
READY

In a teleprinter system, stop the program by simultaneously pressing the CTRL and the S keys. If the program is outputting to the teleprinter when you want to break, type any key. BASIC will suspend output to the teleprinter. Then simultaneously press the CTRL and S keys to break. Typing any other key will cause BASIC to resume output to the teleprinter.

<sup>1</sup>ATS BASIC FOR AUTOMATIC TEST SYSTEMS, 31 July 1971, published by Hewlett-Packard Automatic Measurement Division, under part No. 09500-90104.

## **SYSTEM COMMANDS**

BASIC system commands differ from BASIC statements in two ways. First, commands do not contain a line number (that's how the Interpreter distinguishes between them). Secondly, they are executed immediately after the carriage return key is pressed, and are not stored in the work-space file. Table 9-1 is a list of the system commands available with Cassette BASIC.

## **STATEMENTS**

In addition to the system commands, some statements have been added to ATS BASIC to facilitate cassette I/O, while others have been removed. The statements LOAD and SAVE, which apply to paper tape, have been removed from ATS BASIC. Table 9-2 contains a description of the statements which have been added as well as those whose meaning must be explained in the context of Cassette BASIC.

Table 9-1. Commands

<b>RUN</b>	<p>General Form: RUN</p> <p>Initiates execution of the current program contained in the workspace file.</p>
<b>CTRL-R*</b>	<p>General Form: While the CTRL key is held down, the R key is pressed.</p> <p>Alternate means of executing the current program. Effect is same as RUN, except carriage return is not required, and RUN is output.</p>
<b>DSP</b>	<p>General Form: DSP <i>statement #, statement #</i>          DSP <i>statement #</i>          DSP</p> <p>Example: DSP 20, 100</p> <p>Outputs to the display device all or part of the program currently in the work-space file. When the command is used with no statement numbers, the entire program is listed. When only one statement number is furnished, that statement alone is listed. When two statement numbers are furnished, that part of the program starting with the first statement number specified and ending with the second number specified is displayed.</p>
<b>LIST</b>	<p>General Form: LIST <i>statement #, statement #</i>          LIST <i>statement #</i>          LIST</p> <p>Example: LIST 20</p> <p>Identical to DSP, except output is to list (hard copy) device. If only a display device or a list device is available, such as a teleprinter-only system, both LIST and DSP output to that device.</p>
<b>SAVE</b>	<p>General Form: SAVE <i>statement #, statement #</i>          SAVE <i>statement #</i>          SAVE</p> <p>Example: SAVE 300, 800</p> <p>Identical to DSP except that output is to Deck 3. When the command is used with no statement numbers the entire program is output. When only one statement number is furnished, that statement alone is output. When two statement numbers are furnished, that part of the program starting with the first statement number specified and ending with the second statement number specified is output. The program is output to deck three starting in its current position. Positioning of deck three, if necessary, can be accomplished using the POS system command. The program is output in ASCII format, one line per record. After the program is output an end-of-file gap mark is written.</p>

\*Available only in teleprinter system.

Table 9-1. Commands (cont'd)

<b>DEL</b>	<p>General Form: DEL <i>statement#</i> , <i>statement#</i>  DEL <i>statement#</i>  DEL</p> <p>Example: DEL 10, 200</p> <p>Deletes all or part of the program from the work-space file. When the command is used without any statement number, the entire BASIC program is deleted. When only one statement number is specified, that statement alone is deleted. The same can be accomplished by typing the statement number and the RETURN key. If two statement numbers are specified, the beginning and ending statements indicated and everything between them are deleted. Remember that BASIC does not respond with READY after this command is performed.</p>
<b>LOAD</b>	<p>General Form: LOAD <i>file #</i>  LOAD</p> <p>Example: LOAD 6</p> <p>Delete the current program and load into the work-space file the program contained on the specified file of deck two. If a file number is not specified, loading begins from Deck 2 in its current position. If a file number is specified, the deck is positioned to the start of the specified file prior to loading. The program is expected to be stored in ASCII format, one line per record (the command SAVE stores programs in this format). Loading continues until an end-of-file gap is encountered.</p>
<b>APP</b>	<p>General Form: APP <i>file #</i>  APP</p> <p>Example: APP</p> <p>Append to the program currently in the work-space file the program contained on the specified file of deck two. This command duplicates the LOAD command except that the automatic deletion of the current program is eliminated.</p>
<b>POS</b>	<p>General Form: POS <i>file #</i> ON <i>deck #</i></p> <p>Example: POS 4 on 3</p> <p>Position the specified deck to the start of the specified file. The deck number may be either two or three. Remember that since BASIC is keeping track of the file positions of both decks, the deck will only be rewound if necessary.</p>
<b>EXEC</b>	<p>General Form: EXEC</p> <p>Returns control to the EXEC. A system tape must be in Deck 1. The command transfers control to the System Loader, which rewinds Deck 1, skips to the second file (assumed to contain the EXEC), loads and executes it.</p>

Table 9-2. Statements

**PRINT ON**General Form: *statement # PRINT ON expression, expression, . . .**statement # PRINT ON expression, "any text", . . .**statement # PRINT ON expression, any combination of text and/or expressions**statement # PRINT ON expression*

Example: PRINT ON 3, "VALUE = "; Q  
 PRINT ON D, A, B, C  
 PRINT ON 2.

Statement PRINT ON is analogous to the PRINT statement, except that the data goes to the specified deck of the cassette unit rather than to the print device. The expression immediately following the "ON" is the deck number, and must evaluate to two or three (the user is prevented from outputting to deck one to protect the system tape). The field following the first expression is identical to the field following the normal PRINT expression, and must be separated from the first expression by a comma. There is direct correspondence between a line of output to the print device via a PRINT statement and a record of output to the cassette from a similar PRINT ON statement. The following example illustrates the point:

```
10 LET X=5
20 LET Y=10
30 PRINT X,
40 PRINT Y, X
50 PRINT Y
```

This produces the following output (fields are 15 characters long):

```
5          10          5
10
```

A similar program to output the data to Deck three would be:

```
10 LET X=5
20 LET Y=10
30 PRINT ON 3, X,
40 PRINT ON 3, Y, X
50 PRINT ON 3, Y
```

This produces two records on the cassette:

```
5          10          5      (Record 1)
10                                     (Record 2)
```

Since information must be output to the cassette a full record at a time, statement 30 in the second program above produces no output to the cassette unit. The trailing comma indicates that more data is coming for the current line, so the system holds the partial line in an intermediate buffer, outputting the complete line upon execution of statement 40. The data is output in ASCII format and is compatible with the INPUT ON statement. The data can be listed with the EXEC using the LIST command.

Table 9-2. Statements (cont'd)

**INPUT ON**      General Form: *statement # INPUT ON expression, variable, variable, . . .*

Example: 10    INPUT ON 3, A, B, C  
              20    INPUT ON D, X

Statement INPUT ON is analogous to the INPUT statement, except that data is input from the Cassette Unit. The expression following ON is the deck on which the input is performed and must evaluate to 2 or 3. The variable field after the first expression is identical to that in a normal INPUT statement. Data must be in ASCII format, as produced by the PRINT ON statement (or the WRITE command in the EXEC). Data items may be separated by spaces or commas as with the INPUT statement. Since the cassette unit must read a record at a time and no data buffering is done on input, each INPUT ON statement causes a new record to be read.

**POS**            General Form: *statement # POS expression ON expression*

Example: 10    POS 10 ON 3  
              20    POS X ON 2  
              30    POS 5 ON 1

This statement positions the specified deck to the start of the specified file. The first expression specifies the file and must evaluate to a positive number. The expression following ON specifies the deck number and must evaluate to 2 or 3. Since BASIC is keeping track of file positions on decks 2 or 3, the system will rewind the deck only if necessary.

**WEOF**           General Form: *statement # WEOF ON deck #*

Example: 20    WEOF ON 3

This statement writes an end-of-file gap and mark on the cassette in the specified deck (2 or 3).

**CHAIN**          General Form: *statement# CHAIN expression ON expression*

Example: 10    CHAIN 0 ON 2  
              20    CHAIN X ON Y  
              30    CHAIN 3 ON 3

This statement allows a BASIC program to cause another BASIC program on a separate file to be loaded and executed without operator intervention. When the CHAIN statement is executed, the current program is deleted from the work-space file, the specified cassette is positioned to the correct file (if specified), and the program is loaded into the work-space file and executed. The expression specifies the file containing the BASIC program, and must be positive. If the expression for the file number is zero, the program in the file currently positioned in Deck 2 is loaded. Data may be passed between chained programs in common, via the COM statement.

**Error Messages**

See the ATS BASIC Manual for error messages not described below. If you're using the Cassette Operating System with a measurement system, refer to the Manual for error messages that apply to the measurement system itself.

The message ERROR DST-1 IN LINE YYY is issued if a "call" parameter is an expression or number when it should have been a variable, or if an array parameter's dimension isn't large enough.

The messages below may be issued for errors directly related to the Cassette Unit. After outputting the error message, the system goes to the READY point.

The general format of the error messages is:

ERROR CASSETTE-XX IN LINE YYY

where XX is the error number.

YYY is the line number in which error occurred.

*Table 9-3.. Cassette BASIC Error Messages*

Error No.	Condition
1	Specified deck not ready.
2	A write attempt was made on a write-protected deck.
3	End-of-file encountered where not expected.
4	End of tape.
5	Invalid deck number (must be 2 or 3).
6	Read error. This may be the result of bad data, a bad cassette, or a faulty cassette.
7	Write error. This may be the result of a bad cassette or faulty cassette unit.
8	Missing ON in statement or system command.
9	File number error. A negative or zero file number was requested in a POS statement.
10	Rewind error. The system issued a rewind command to the cassette unit; when the unit went READY the tape was not on clear leader, indicating an equipment failure.

## APPENDIX A

### PROTECTED BINARY CASSETTE LOADER

#### DESCRIPTION

The Protected Binary Cassette Loader (PBCL) is the absolute program that resides in the upper 64 protected memory locations of the computer. It is used to load absolute programs from the cassette in Deck 1 into memory.

#### PROCEDURES FOR THE 2116

1. Be sure the computer is halted.
2. Insert the cassette containing the absolute program to be loaded in Deck 1. (If necessary, position — in the OFF-LINE mode — the tape to the desired file).
3. Set the switch register to the proper starting address for the particular memory size.

8K — 17700  
12K — 27700  
16K — 37700  
24K — 57700  
32K — 77700

4. Press the LOAD ADDRESS button.
5. Enable the Loader by lifting the LOADER switch up to ENABLED.
6. Press PRESET; RUN.
7. When the program has been successfully loaded, the computer halts with 102077 in the Memory Data Register.
8. Protect the loader by putting the LOADER switch DOWN to PROTECTED.

#### NOTE

After loading, the P-Register will contain the address 2. Any programs beginning at address 2 may be initiated by pressing the PRESET and RUN buttons.

#### Checksum Option

To check an absolute file on a cassette for checksum errors without actually loading it into memory, follow the operating procedures described above with one exception:

In step 6, lift switch 0 of the switch register up before pressing RUN.

#### PROCEDURES FOR THE 2100

1. Be sure the computer is halted, and the switch register is all zeroes.
2. Insert the cassette containing the absolute program to be loaded in Deck 1. (If necessary, position the cassette containing the absolute program to be loaded in Deck 1.
3. Poke the P button.
4. Set the DISPLAY REGISTER to the proper starting address for the particular memory size:

8K — 17700  
12K — 27700  
16K — 37700  
24K — 57700  
32K — 77700

5. Press the S-Register button, and then the CLEAR DISPLAY button. Press the following buttons (in order):

INTERNAL PRESET  
EXTERNAL PRESET  
LOADER ENABLE  
RUN

When the program has been successfully loaded, the computer halts with 102077 in the DISPLAY REGISTER.

NOTE: After loading, the P-Register will contain the address 2. Any programs beginning at address 2 may be initiated by pressing INTERNAL PRESET, EXTERNAL PRESET and RUN.

Checksum Option

To check an absolute file on a cassette for checksum errors without actually loading it into memory, follow the operating procedures described above with one exception. Insert between steps 4 and 5.

- 4A — Poke the S Button  
4B — Set the DISPLAY REGISTER to 1.

ERROR  
CONDITIONS

The following error halts are possible during execution of the PBCL.

HALT	Explanation
102011	Checksum error. Check the tape for lint, dust or other particles. See Note 1.
102013	Tape error. Check the tape for creases or ragged edges.
102055	Address error. Check that the proper tape is being loaded.
NOTE: the A-Register contains the tape checksum. the B-Register contains the computed checksum.	

CONTENTS OF  
PBCL

The memory locations in the upper 64 protected words of core should look like this:

Contents of PBCL

	0	1	2	3	4	5	6	7
0x7700	063767	106501	004010	002400	073727	017733	001727	003000
0x7710	073774	017733	073775	070001	037774	027722	017733	050001
0x7720	017742	102011	063775	043770	002021	102055	017733	000000*
0x7730	044000	037775	027714	000000*	017742	001727	073776	017742
0x7740	033776	127733	000000*	063773	1026cc	1037cc	1023cc	027746
0x7750	1025cc	002020	102013	001222	002021	027761	1067cc	067771
0x7760	024001	001722	002020	027705	1025cc	013772	127742	173775
0x7770	1n0100	102077	000377	004400**000000*	000000*	000000*	000000*	000000*

\*These locations may be other numbers than all zeroes.

\*\*Modification of this instruction will result in altering the deck number from which the PBCL loads.

- 005000 PBCL loads from Deck 2.  
005400 PBCL loads from Deck 3.

X = 1 for 8K  
 2 for 12K  
 3 for 16K  
 5 for 24K  
 7 for 32K

cc = I/O channel for the 85001A Cassette Input/Output Unit.

n = 6 for 8K  
 5 for 12K  
 4 for 16K  
 2 for 24K  
 0 for 32K

## RESTORATION PROCEDURES FOR THE 2116

Should the PBCL become partially or totally destroyed in the 2116, use this procedure to restore it:

1. Set the Switch Register to 22<sub>8</sub> .
2. Press LOAD ADDRESS .
3. Load the following octal instructions into memory: (i.e., set the Switch Register to the octal instruction, then press LOAD MEMORY)

Location	Octal Instruction
22	064050
23	014035
24	001727
25	070052
26	014035
27	030052
30	170001
31	006004
32	054051
33	102077
34	024023
35	000000 **
36	060046
37	1026cc
40	1037cc
41	1023cc
42	024041
43	1025cc
44	010047
45	124035
46	004400 *
47	000377
50	0X7700
51	mm0000

x = 1 for 8K  
 2 for 12K  
 3 for 16K

cc = I/O channel for the cassette.

mm = 02 for 8K  
 03 for 12K  
 04 for 16K

\*Modification of this instruction will result in altering the deck number from which the Cassette Bootloader will be loaded.

005000 Cassette Bootloader is loaded from Deck 2.

005400 Cassette Bootloader is loaded from Deck 3.

\*\*May be some number other than all zeroes.

4. Set the Switch Register to  $22_8$
5. Press LOAD ADDRESS.
6. Insert the tape containing the Protected Binary Cassette Loader into Deck 1 and ready the deck.
7. Enable the Loader by lifting the LOADER switch up to ENABLED.
8. Press PRESET, RUN.
9. When the Protected Binary Cassette Loader has been read, the computer halts with 102077 in the Memory Data Register.
10. Protect the Loader by putting the LOADER switch down to PROTECTED.

#### RESTORATION PROCEDURES FOR THE 2100

Should the PBCL become partially or totally destroyed in the 2100, use this procedure to restore it:

1. Poke the M Button.
2. Set the DISPLAY REGISTER to  $22_8$ .
3. Poke the MEMORY DATA button.
4. Load the octal instructions on page A-3 into memory (i.e., set the DISPLAY REGISTER to the octal instruction; then press INCREMENT M).
5. Poke the P button.
6. Set the DISPLAY REGISTER to  $22_8$ .
7. Insert the tape containing the Protected Binary Cassette Loader into Deck 1 and ready the deck.
8. Press INTERNAL PRESET, EXTERNAL PRESET, LOADER ENABLE, RUN.
9. When the Protected Binary Cassette Loader has been used, the computer halts with 102077 in the DISPLAY REGISTER.

#### ALTERNATE DECKS

With a simple modification, either of the other two decks (Deck 2 or Deck 3) may be used to load absolute programs or to load the Protected Binary Cassette Loader (during restoration).

To modify the PBCL so that it will load absolute programs from a deck other than Deck 1, enable the Loader; then change the instructions at x7773 from 004400 to

005000 — to load from Deck 2

005400 — to load from Deck 3.

To modify the restoration routine so that it will load the Protected Binary Cassette Loader from a deck other than Deck 1, change the instruction at 46 from 004400 to

005000 — to load from Deck 2

005400 — to load from Deck 3.

## APPENDIX B

### SYSTEM LOADER (SYSLD)

#### DESCRIPTION

The System Loader is the core resident program that occupies the 200<sub>8</sub> memory locations directly below the Protected Binary Cassette Loader. It loads absolute binary programs from the cassette unit into memory and begins execution of that program (at the first address encountered on the tape). The System Loader essentially has two functions: to load and execute the EXEC and any other absolute program. Which of these options is selected is determined by the entry address:

Address	Explanation
0X7500	The System Loader will load and execute the EXEC from File 2 of the cassette in Deck 1 (a system tape).
0X7510	The System Loader will load and execute the next file from whatever deck number is in the A Register.
X = 1 for 8K 2 for 12K 3 for 16K 5 for 24K	

#### OPERATION

The System Loader operates like a Protected Binary Cassette Loader with some additional features -- load-and-go, increased error checking, and search-for-EXEC. If entry is made at X7500, SYSLD will first turn off the interrupt system and clear all control bits on I/O devices. Then it checks Deck 1 for deck ready and if ready, will rewind it and skip one file. This should position it to the beginning of the EXEC if a system tape is in Deck 1. Finally, the A Register is loaded with deck number = 1 and the program proceeds to X7510. At this point SYSLD does not know whether it was called to load the EXEC or a user program. Operation is identical from here on.

SYSLD then turns off the interrupt system and clears all control bits again (this assures clearing regardless of which entry address was used). The reason for this action is to stop all I/O from the previous program since a new and different program is about to be loaded into core. The deck number in the A Register is then checked to see if it is valid (1, 2, or 3). Provided the deck number is valid, the loader reads the first word count and address from the designated deck. *It saves this first address as the location to jump to after the end-of-file is encountered.*

The System Loader then continues to read and load into core each absolute record from the designated deck until it finds an end-of-file. The checksum is kept in the B register and output to the switch register (this lets the user know something is happening). Finally, it waits for the deck to go ready. When the deck goes ready, all I/O control bits are cleared and execution transfers to the address of the first word of the first record read from the tape.

NOTE: Since the System Loader is core resident, certain locations are used by the system software. They are:

- X7677: Used by SIO cassette driver to tell CRT driver that it is busy so that pushing the copy button will not destroy read or write operation.
- X7676: Used by EXEC to store file # of last system program loaded. For example, on any system tape, FTN, pass 1 can find what file # it is and thus know where FTN pass 2 is.
- X7675: Used by Microwave system software.

**OPERATING  
PROCEDURES  
FOR THE 2116**

Assume the System Loader has been loaded by PBCL into core.

A. EXEC loading

1. Make sure all I/O peripherals are turned on.
2. Insert a System Tape into Deck 1 and ready the deck.
3. Set the switch register to the proper starting address for the particular memory size:

17500 — 8 K  
27500 — 12K  
37500 — 16K  
57500 — 24K  
77500 — 32K

4. Press LOAD ADDRESS.
5. Press PRESET, RUN.

B. Program Loading

1. Make sure all I/O peripherals are turned on.
2. Insert the cassette containing the absolute file to be loaded into the desired deck. (If necessary, position the cassette OFF-LINE to the desired file).
3. Set the Switch Register to the deck number of the deck containing the absolute program to be loaded.
4. Set the Switch Register to the proper starting address for the particular memory size.

17510 — 8K  
27510 — 12K  
37510 — 16K  
57510 — 24K  
77510 — 32K

6. Press LOAD ADDRESS.
7. Press PRESET, RUN.

**OPERATING  
PROCEDURES  
FOR THE 2100**

Assume the System Loader has been loaded by PBCL into core.

A. EXEC loading

1. Make sure all I/O peripherals are turned on.
2. Insert a system tape in Deck 1 and ready the deck.
3. Poke the P button.
4. Set the DISPLAY REGISTER to the proper starting address for the particular memory size.

17500 — 8K  
27500 — 12K  
37500 — 16K  
57500 — 24K  
77500 — 32K

5. Press INTERNAL PRESET, EXTERNAL PRESET, RUN.

#### B. Program Loading

1. Make sure all I/O peripherals are turned on.
2. Insert into the desired deck the cassette containing the absolute file to be loaded (if necessary position the cassette off-line to the desired file).
3. Poke the A Button.
4. Set the DISPLAY REGISTER to the deck number of the deck containing the absolute program to be loaded.
5. Poke the P Button.
6. Set the DISPLAY REGISTER to the proper starting address for the particular memory size.

17510 — 8K  
 27510 — 12K  
 37510 — 16K  
 57510 — 24K  
 77510 — 32K

7. Press INTERNAL PRESET, EXTERNAL PRESET, RUN.

#### PROGRAMMING INFORMATION

Either function of the System Loader (EXEC loading and program loading) may be used under program control.

#### ASSEMBLY ENVIRONMENT

To load and execute the EXEC from a relocatable ASSEMBLY language program, the program should contain the following code:

```
EXT HALT
.
.
.
JMP HALT
```

(The HALT entry point resides in the BCS STOP routine. An entry point (EXEC) within this routine is set at Cassette BCS time to the proper starting address of the System Loader X7500).

To load and execute the EXEC from an absolute ASSEMBLY language program, the program should contain the following code:

```
JMP EXEC, I
.
.
.
EXEC OCT X7500
```

To load and execute a user program from an ASSEMBLY language program, the program should contain the following code:

```
LDA DECK
JMP SYSLD, I
SYSLD OCT X7510
DECK OCT (either 1, 2, or 3)
```

## System Loader (SYSLD)

where       X = 1 for 8K  
              2 for 12K  
              3 for 16K  
              5 for 24K  
              7 for 32K

### FORTTRAN ENVIRONMENT

To load and execute the EXEC from a FORTRAN program, the program should contain the following statement:

STOP

Execution of this statement causes the RESTART? question to be asked. A response of "N" returns control to the EXEC by executing a JMP to the HALT entry point in the BCS STOP routine.

### BASIC ENVIRONMENT

In the BASIC environment the EXEC is loaded and executed by typing the command:

EXEC

This results in a JMP to the HALT entry point in the BCS STOP routine.

### ABSOLUTE PROGRAM STARTING ADDRESS

Since the System Loader loads and *executes*, there must be some convention for determining the address at which execution will begin. The convention chosen was this -- the first absolute address encountered on the tape is the address to which the System Loader transfers control after the entire program has been loaded. Absolute programs produced by Cassette BCS have the correct starting address output first, but absolute ASSEMBLY language programs must take special precautions. The first instruction of an absolute ASSEMBLY language program must be either the beginning of program execution or a jump to the beginning of program execution. For example:

	ORG 100B	
	JMP BEGIN	<i>1st instruction — jump to beginning.</i>
	BSS 7	<i>SIO links.</i>
BEGIN		<i>Beginning of program execution.</i>

### ERROR CONDITION

If the tape does not load properly while executing the System Loader, check the Memory Data Register/DISPLAY REGISTER for the following error halt conditions.

HALT	Explanation	Action
102011	Checksum error "A"-Register-tape checksum "B"-Register-computer checksum	Reset the P-Register to the starting address and try again.
102013	Tape error or cassette put off-line while loading.	Reset the P-Register to the starting address and try again.
102022	Deck not ready.	Ready the deck. Press RUN.
102033	Illegal deck number.	Change the deck number in the "A"-Register to 1, 2, or 3. Set the P-Register to X7510 and press PRESET, RUN.
102044	Rewind error - no leader after rewind.	Set the P-Register to X7500 and try again or manually rewind the deck and try again.
102055	Address error.	Check to see if the proper tape is being used. Reset the P-Register to the starting address and try again.

## APPENDIX C

### CASSETTE SIO DRIVER ERROR MESSAGES

The 85001A Cassette SIO driver has the capability of detecting a number of different types of errors. The particular error type will be identified by a message typed on the SIO list device. With messages other than EOF, the driver waits for information from the user before continuing.

Message	Error
DK # EOF	End-of-file (EOF) detected on the designated deck. Tape motion is terminated in the inter-record gap between the file mark record and the start of the next record.
DK # R/W ERR	A read/write tape error has been detected during a read operation. Tape motion will be terminated at the end of that record. Recoverable except that the current record will be truncated to the incorrect byte.
DK #NOT RDY	The designated deck was not ready. Recoverable.
DK #EOT	End-of-tape (EOT) has been sensed on the designated deck. Not recoverable.
DK #CALL ER	The last call to the driver did not fit any of the allowable formats -- includes check on number of skips, size of buffer for reads or writes. Not recoverable. No tape motion occurs.
DK #W. LKOUT	An attempt to write on a write-protected tape was thwarted. Recoverable.
# is replaced by the actual DECK number.	

For recoverable errors, type "space" to try again. Otherwise, type "control-c" to return to the calling program.

## APPENDIX D

### SOFTWARE APPLICABILITY

This manual applies specifically to the programs identified below.

#### I. Absolute Core-Size Independent Programs.

Program	Source Part No.	Absolute Part No.	Revision
EXEC	08500-90524	08500-90684	C
ALGOL	08500-90683	08500-90684	
ASSEMBLER	08500-90761	Non-EAU version 08500-90762	
		EAU version 08500-90763	
XREF	08500-90685	08500-90686	
FTN:			
Pass 1	08500-90633	08500-90634	
Pass 2	08500-90635	08500-90636	
EDITOR	08500-90527	08500-90528	

#### II. Protected Binary Cassette Loader.

Source Part No. 08500-90639

Absolute Tape Part No. 08500-90640 for 8K  
08500-90641 for 12K  
08500-90642 for 16K

#### III. SIO Package.

The SIO package must contain one of the MTC1 and SYSLD defined below:

##### MTC1

Source Part No. 08500-90629

Absolute Part No. 08500-90630 for 8K  
08500-90631 for 12K  
08500-90632 for 16K

##### SYSLD

Source Part No. 08500-90506

Absolute Part No. 08500-90507 for 8K  
08500-90508 for 12K  
08500-90509 for 16K

IV. BCS Relocating Loader

Source Part No. 08500-90880

Relocatable Part No. 08500-90881

Absolute Reconfigurable Loader (RLDR) Part No. 08500-90595 Rev. D

